

PROGRAM AND ABSTRACTS FOR THE TWENTY-
SECOND ANNUAL MEETING OF THE AMERICAN
SOCIETY OF ZOÖLOGISTS

WASHINGTON, D. C., DECEMBER 29-31, 1924

These titles and abstracts make up the 1924 program of the American Society of Zoölogists. They were received either by the Secretary of the Society or by the Secretary of the joint Genetics Sections of the Society with the Botanical Society of America on or before November 20th and have been arranged according to the accepted program rules.

The abstracts are in the form contributed by their authors. They have been edited only to secure a uniform system of titles and to reduce length when obviously overlong. Their arrangement and the planning of the program can be done only after the titles are all in hand and must be greatly rushed in order to obtain publication before the meetings. The Wistar Institute is scheduled to mail out this issue of *The Anatomical Record* three weeks, to the day, after receiving the manuscript. All proofreading will be done there. They deserve great credit for making possible the early publication and distribution of this material.

These abstracts and the accompanying historical data and revised membership list are presented as a part of the official proceedings of the 1924 meetings of the Society. The minutes of these meetings will appear in the January number of this journal. The symposium papers will be published in *The American Naturalist* early in 1925.

TENTATIVE PROGRAM

The tentative program shows the approximate half-day on which papers will appear. The announcement here should be checked against the data given in the program of the American Association for the Advancement of Science, which will show also the rooms to be occupied during the different sessions. The information concerning the Genetics Sections has been furnished by their secretary, Dr. D. F. Jones.

All of the day sessions will be held in the Central High School Building.

MONDAY, DECEMBER 29

10.00 A.M.¹ General and Comparative Physiology.

2.00 P.M. a. General and Comparative Physiology (concluded) and Endocrinology.

b. Genetics.

6.00 P.M. Informal conference on the teaching of Zoölogy.

All those interested in the problems of teaching zoölogy with particular reference to the elementary college course are requested to meet for dinner at the City Club, 1320 G Street (\$2.00 a plate). The topic under discussion will be the aim of teaching in the elementary courses. This will be briefly discussed by R. A. Budington, E. G. Conklin, A. F. Shull, and C. P. Sigerfoos. General discussion will follow. This conference was initiated and arranged by H. S. Colton. All interested zoölogists are invited.

9.00 P.M. Biological Smoker, National Research Building.

TUESDAY, DECEMBER 30—CENTRAL HIGH SCHOOL

9.00 A.M. a. Miscellaneous.

Cytology.

Embryology.

Comparative Anatomy.

b. Genetics.

2.00 P.M. Evolution.

2.30 P.M. Address: Edward L. Rice, retiring Vice-President of Section F.

3.25 P.M. Business session of Section F.

3.30 P.M. Business session of Zoölogists.

4.30 P.M. Inspection of exhibits.

¹ Section N holds its annual program at this time.

WEDNESDAY, DECEMBER 31—CENTRAL HIGH SCHOOL

- 9.00 A.M. a. Protozoology.
Parasitology.
b. Genetics.
- 2.00 P.M. Symposium. Sex determination and sex differentiation.
Sex determination and sex differentiation in the higher plants.
John H. Schaffner, Ohio State University, representing the American Society of Plant Physiologists.
Sex in relation to chromosomes and genes. Calvin B. Bridges, Columbia University.
Sex and the parthenogentic bi-sexual cycle. A. Franklin Shull, University of Michigan.
The problem of sex differentiation. W. W. Swingle, Yale University.
Sex determination and differentiation in birds and mammals. Carl R. Moore, University of Chicago.
- 7.00 P.M. Zoölogists' Dinner, Hotel Raleigh (headquarters hotel). All biologists are invited to attend.
The dinner address will be given by M. F. Guyer, retiring President of the Society.

THURSDAY, JANUARY 1—CENTRAL HIGH SCHOOL

- 10.00 A.M. Joint meeting with Ecological Society of America.

LIST OF TITLES

GENERAL AND COMPARATIVE PHYSIOLOGY

1. Some factors which influence the nature of after-nystagmus in the white rat. J. A. Detlefsen, The Wistar Institute (15 min.)
2. The specificity of hemolytic antibodies. Roscoe R. Hyde, Johns Hopkins University. (10 min.)
3. Structure and locomotion in *Amoeba proteus*. S. O. Mast, Johns Hopkins University. Lantern. (15 min.)
4. The relative susceptibility to x-rays of the eggs and sperm of *Arbacia*. James W. Mavor and David M. DeForest, Union College. (By title.)
5. The ability of termites to live perhaps indefinitely on a diet of pure cellulose. L. R. Cleveland, National Research Council Fellow, Johns Hopkins University. (5 min.)
6. The effect of temperature on rate of embryonic development of certain Orthoptera (grasshoppers). Joseph Hall Bodine, University of Pennsylvania. Lantern. (15 min.)
7. Heat production by the echinoderm egg during fertilization and early cleavage. C. G. Rogers and K. S. Cole, Oberlin College. (15 min.)
8. Rate of growth and age of sexual maturity of certain sessile organisms. B. H. Grave, Wabash College. Demonstration. (10 min.)
9. Periodic reversal in direction of heart beat in the chrysalis of *Colias*. John H. Gerould, Dartmouth College. Lantern. (15 min.)
10. Some physiological actions of cyanides. Joseph Hall Bodine, University of Pennsylvania. (10 min.)
11. Respirations in the tissues of mollusks in relation to age. H. S. Hopkins, Iowa State College. (By title.)
12. Respiratory differences along the axis in *Grantia* and *Tubularia*. Libbie H. Hyman, University of Chicago. (By title.)
13. Effects of different tensions of carbon dioxide on certain Orthoptera (grasshoppers). Josephine Willis McNabb, University of Pennsylvania. Introduced by Joseph Hall Bodine. (15 min.)
14. Metabolism during embryonic development of eggs and metamorphic changes of pupae of insects. David E. Fink, University of Pennsylvania. Introduced by Joseph Hall Bodine. Lantern. (15 min.)
15. The regulation of body volume in fresh-water organisms. Edward F. Adolph, Johns Hopkins University. Lantern. (15 min.)
16. A new index to the function of coloration in fishes. W. H. Longley, Goucher College. Lantern. (15 min.)
17. Physiology of the color pattern in butterflies of the genus *Colias*. John H. Gerould, Dartmouth College. Lantern. (15 min.)
18. Seasonal changes in melanic pigmentation in butterflies of the genus *Colias*. John H. Gerould, Dartmouth College. Lantern. (10 min.)
19. The process of awakening from hibernation in the thirteen-lined ground-squirrel (*Citellus tridecemlineatus*). George Edwin Johnson, Kansas State Agricultural College. Introduced by Robert K. Nabours. Lantern. (15 min.)

20. Photoreceptors of the earthworm, *Lumbricus terrestris*, with special reference to their distribution, function, and structure. Walter H. Hess, Johns Hopkins University and DePauw University. Demonstration. (15 min.)
21. The relation between illumination and the stimulating efficiency of intermittent light of different ratios between the duration of the flashes and the dark periods. William L. Dolley, Jr., Randolph-Macon College, and S. O. Mast, Johns Hopkins University. Charts. (15 min.)
22. Reactions of the cyprid larvae of barnacles to spectral colors. J. Paul Visscher, U. S. Bureau of Fisheries. Introduced by S. O. Mast. (10 min.)
23. *Modifiability in behavior in honeybees. Bruce Lineburg, Lake Forest College. (15 min.)
24. *The relation between the responses to mechanical shock and to sudden increase in illumination in *Amoeba proteus*. Harry T. Folger, University of Michigan. Introduced by A. F. Shull. (15 min.)
25. Metamorphosis to the dissoconch stage without attachment in the veligers of *Ostrea* and of *Mytilus*. Thurlow C. Nelson, Rutgers University. Lantern (15 min.)
26. The experimental production of osteoclasts in the femur of the frog. H. E. Jordan, University of Virginia. Lantern. (10 min.)
27. *Experimental regression and redevelopment in *Corymorpha palma*. C. M. Child, University of Chicago. (15 min.)
28. Inhibiting agencies in ontogeny and regeneration. Herbert W. Rand, Harvard University. (15 min.)
29. The physiological basis of wing production in Aphids. Lloyd Ackerman, University of Michigan. Introduced by A. F. Shull. Lantern. (15 min.)

ENDOCRINOLOGY

30. Thyroid adrenal association. Frederick S. Hammett, The Wistar Institute. Lantern. (15 min.)
31. The depressant action of thyroxin on cell division. Harry Beal Torrey, University of Oregon. Lantern. (15 min.)
32. The 'retrograde metamorphosis' of the Sirenidae; experiments on the functional activity of the thyroid of the perennibranchs. G. K. Noble, The American Museum of Natural History. Lantern. (10 min.)
33. Concerning the effect of thyroid constituents on protoplasm in general. Robert A. Budington, Oberlin College. Lantern. (10 min.)
34. Some factors involved in the metamorphosis of the Colorado axolotl. W. W. Swingle, Yale University. Lantern. (15 min.)
35. Endocrine glands and bilateral symmetry; observations upon forelimb eruption in frog larvae under treatment with thyroid and thymus extracts. C. C. Speidel, University of Virginia Medical School. Lantern. (15 min.)
36. Factors involved in the formation of the opercular leg perforation in anuran larvae during metamorphosis. O. M. Helff, Yale University. Introduced by W. W. Swingle. Lantern. (15 min.)

* The star designates those members who were still uncertain on November 20th of the possibility of attending the meetings.

37. Extirpation and transplantation of the hypophysis of fish and amphibians. W. F. Desmond, Yale University. Introduced by W. W. Swingle. (15 min.)
38. Is the adrenal cortex essential for life? R. L. Zwemer, Yale University. Introduced by W. W. Swingle. Lantern. (15 min.)

MISCELLANEOUS

39. On the development and encouragement of science instruction in American colleges and universities, 1912-1922, with especial reference to biological science. N. M. Grier, Dartmouth College. Lantern. (15 min.)

CYTOLOGY

40. The origin of the 'ameboocytes with spherules' in *Arbacia*. James E. Kindred, University of Virginia. (10 min.)
41. Formative cells of planarians. Winterton C. Curtis and Lula M. Schulze, University of Missouri. Lantern. (15 min.)
42. Giant cells in cultures of amphibian tissues. George A. Baitsell, Yale University. Lantern. (15 min.)
43. *Intracellular digestion and assimilation in the phagocytic cells of the intestine of *Planaria*. B. H. Willier, University of Chicago. (15 min.)
44. The maturation divisions and the segregation of heteromorphic homologous chromosomes. E. Eleanor Carothers, University of Pennsylvania. Lantern or opaque projection. (15 min.)
45. The chromosome cycle in the rotifer, *Asplanchna intermedia*. David D. Whitney, University of Nebraska. (By title.)

EMBRYOLOGY

46. Primordial sex cells of the albino rat. Geo. T. Hargitt, Syracuse University and The Wistar Institute. Lantern. (15 min.)
47. Histogenesis of red sponge, *Microciona prolifera* Ver., from dissociated tissue cells. Paul S. Galtsoff, U. S. Bureau of Fisheries. Lantern. (15 min.)
48. The response of the developing limb of *Amblystoma punctatum* to variations in the orientation of the surrounding tissue. J. S. Nicholas, University of Pittsburgh School of Medicine. Lantern. (15 min.)
49. Partial pluteus larvae from isolated blastomeres of the two-cell stage of the egg of *Arbacia*. Harold H. Plough, Amherst College. Lantern. (5 min.)
50. Ectodermal areas of the head in young human embryos. G. W. Bartelmez, University of Chicago and Carnegie Institution of Washington. (By title.)
51. Variation in the temperature coefficient of embryonic development of the grape leaf-hoppers. Chester I. Bliss, Fruit Insect Investigations, U. S. Department of Agriculture. Introduced by R. H. Bowen. Lantern. (15 min.)
52. Experimental study of the development of the heart of *Amblystoma*. W. M. Copenhaver, Yale University. Introduced by R. G. Harrison. Lantern. (10 min.)

COMPARATIVE ANATOMY

53. The integumentary, pulmonary and cardiac modifications correlated with increased cutaneous respiration in the amphibia. G. K. Noble, The American Museum of Natural History. Lantern. (15 min.)
54. Cephalic glands of snakes and crocodiles. Albert M. Reese, West Virginia University. Charts. (10 min.)
55. Mechanisms in ciliated epithelia of the gill of the oyster by which ciliary movement may be coordinated. Caswell Grave and F. O. Schmitt, Washington University. Demonstration. (15 min.)
56. Aberrant secondary sexual characters in the crayfishes (*Cambarus*). C. L. Turner, Beloit College. Lantern. (15 min.)
57. The reproductive system of *Apotettix eurycephalus* Hancock. Mary T. Harman, Kansas State Agricultural College. Lantern. (15 min.)
58. Abnormalities in number and location of the gonads of certain Lumbricidae. Frank Smith, University of Illinois. Lantern. (10 min.)
59. A case of unilateral or true gynandromorphism in a leopard frog. H. V. Neal, Tufts College. Lantern. (10 min.)
60. The rabbit egg as a taxonomic character. Carl G. Hartman, University of Texas. (By title.)
61. The gonads of a sex-intergrade opossum. Carl G. Hartman and Bessie League, University of Texas. (By title.)

EVOLUTION

62. Factors in the evolution and phylogeny of the Proboscidea. Henry Fairfield Osborn, American Museum of Natural History. (15 min.)
63. Certain features of the termite caste problem. Harold Heath, Stanford University. (10 min.)

PROTOZOOLOGY

64. The opalinid parasites of adult and larval Anura. Maynard M. Metcalf. Opaque projection or charts. (10 min.)
65. A new parasitic Ameba from salmonoid fishes. H. S. Davis, U. S. Bureau of Fisheries. Lantern. (10 min.)
66. Intestinal flagellates in tropical America. Robert W. Hegner, Johns Hopkins University. (10 min.)
67. *Life-history of Haplozoon. Waldo Shumway, University of Illinois. (10 min.)
68. The effects of starvation and oxygenation on the symbiosis between termites and their intestinal protozoa, together with the toxicity of oxygen for free-living and parasitic protozoa. L. R. Cleveland, National Research Council Fellow, Johns Hopkins University. Charts. (15 min.)
69. The structure and division of *Paramecium trichium* Stokes. D. H. Wenrich, University of Pennsylvania. Lantern. (15 min.)
70. Trichomonad flagellates in the coecum of rats and mice. D. H. Wenrich, University of Pennsylvania. Lantern. (15 min.)
71. Conjugation in *Dileptus gigas*. J. Paul Visscher, Western Reserve University. Introduced by S. O. Mast. Lantern. (10 min.)
72. A neuromotor apparatus in *Dileptus gigas*. J. Paul Visscher, Western Reserve University. Introduced by S. O. Mast. (10 min.)

PARASITOLOGY

73. Infection with *Diphyllobothrium*. Thomas Byrd Magath, Mayo Clinic. Lantern. (15 min.)
74. The opalinid parasites and the geographical distribution of the bell-toads (*Discoglossidae*) with a criticism of the age and area hypothesis. Maynard M. Metcalf. Opaque projection or charts. (15 min.)
75. Notes on the relationships of the *Acanthocephala*. H. J. Van Cleave, University of Illinois. Charts; lantern. (15 min.)
76. Effect of parasitism on fowl thymi. James E. Ackert, Kansas State Agricultural College. (10 min.)
77. The effect of the nematode, *Ascaridia perspicillum*, on the blood-sugar content of chickens. James E. Ackert and R. W. Titus, Kansas State Agricultural College. Lantern. (10 min.)
78. An occupational disease of zoölogists. B. H. Ranson and J. F. Couch, U. S. Bureau of Animal Industry. (15 min.)
79. Experiments on the production of soil infestation with hookworm larvae by the use of human excrement as fertilizer. W. W. Cort, Johns Hopkins University. (15 min.)
80. *Infectious anemia of horses; a comparison of field and experimental cases. John W. Scott, University of Wyoming. Lantern. (12 min.)
81. A complete specimen of *Dip. grandis*. Sadao Yoshida and Ryoza Takano, Medical College, Osaka, Japan. (By title.)
82. Main source of *Ascaris* infection in Japan. Sadao Yoshida, Medical College, Osaka, Japan. (By title.)
83. A survey of the marine gastropods from the vicinity of San Juan Island with respect to larval trematode infestation. Harry M. Miller, Jr., Washington University. Introduced by Caswell Grave. Lantern. (10 min.)
84. A new nematode of the rabbit. Bertha L. Danheim, Kansas State Agricultural College. Introduced by James E. Ackert. (By title.)
85. Observations on the occurrence of *Rhabditis hominis* in the United States. J. H. Sandground, Johns Hopkins University. Introduced by W. W. Cort. (15 min.)
86. The viability of hookworm eggs in stored night-soil. N. R. Stoll, Johns Hopkins University. Introduced by W. W. Cort. (15 min.)
87. The larval trematode infestation of fresh-water molluscs of San Juan Island, Puget Sound. Harry M. Miller, Jr., Washington University. Introduced by Caswell Grave. Lantern. (10 min.)
88. Some new parasites of the Bermuda Echinoidea. Ruth Jane Ball, University of Vermont. Introduced by Henry F. Perkins. Charts. (10 min.)
89. The fundamental tissue reaction in kala-azar. Henry Edmund Meleny, Pekin Union Medical College. Introduced by R. W. Hegner. Lantern. (15 min.)

ECOLOGY

90. A sun porch and other equipment for studying the influence of environmental factors on egg production. H. D. Goodale, Mt. Hope Farm, Williamstown, Massachusetts. (15 min.)

91. *The growth of turtles fed on rations of pure foods. A. S. Pearse and S. Lepkovsky, University of Wisconsin. Lantern. (15 min.)
92. Further studies in correlation of shape and station in fresh-water mussels. N. M. Grier, Dartmouth College, and J. F. Mueller, University of Illinois. Lantern. (12 min.)
93. Entomostraca from the Panama Canal Zone. G. S. Dodds, West Virginia University. Lantern. (15 min.)
94. Further studies on Michigan bog lakes. Minna E. Jewell and Harold Brown, University of Michigan Biological Station and Kansas State Agricultural College. Lantern. (15 min.)
95. Measurement of physical factors in the tropical rain forest of Panama. W. C. Allee, University of Chicago. Lantern. (15 min.)
96. The classified continuation card catalog of the bibliography of fishes. E. W. Gudger, American Museum of Natural History. (10 min.)
97. A limnological study of *Hydra oligactis* in Douglas Lake, Michigan. Paul S. Welch and Helen A. Loomis, University of Michigan. Lantern. (10 min.)
98. The distribution of the oilfish, *Ruvettus pretiosus*, in the Pacific Ocean, as shown by the peculiar hook used in its capture. E. W. Gudger, American Museum of Natural History. Exhibit. (15 min.)
99. Additional observations on the fouling of ships' bottoms. J. Paul Visseher, U. S. Bureau of Fisheries. Introduced by S. O. Mast. (10 min.)
100. A preliminary study of the mice of Mount Desert Island. Beatrice W. Johnson, University of Maine. Introduced by C. C. Little. (10 min.)
101. Seasonal succession of animals in a chara-cattail pond. Walburga Petersen, University of Chicago. Introduced by W. C. Allee. Lantern. (15 min.)

GENETICS

102. The mode of expression of factors influencing carbohydrate storage in the endosperm of corn. Lois Lampe and Marion T. Meyers, Ohio State University. (10 min.)
103. Cytology of certain potato species and varieties. Hugh B. Smith, Maine Agricultural Experimental Station, Aroostook Farm, Presque Isle, Maine. (5 min.)
104. Some evidence of hybridity in *Typha*. Muriel V. Roscoe, 61 Garden St., Cambridge, Massachusetts. Lantern. (15 min.)
105. Chromosome behavior during meiosis in the pollen mother cells of certain *Oenotheras*. Ralph E. Cleland, Goucher College, Baltimore, Maryland. Lantern and exhibit. (10 min.)
106. The probable cytological basis for certain genetical peculiarities of *Oenothera*. Ralph E. Cleland, Goucher College, Baltimore, Maryland. Chart. (15 min.)
107. Genetics of four groups of seedling characters which affect the development of chlorophyll in maize. M. Demerec, Station for Experimental Evolution, Cold Spring Harbor, Long Island, New York. Lantern. (10 min.)
108. Inheritance of white seedlings in maize. M. Demerec and R. A. Emerson, Station for Experimental Evolution, and Cornell University. Lantern. (10 min.)

109. The nature of gene changes to form multiple allelomorphs. W. H. Eyster, University of Maine. Lantern. (12 min.)
110. The effect of environment on variegation pattern. W. H. Eyster, University of Maine. Lantern. (5 min.)
111. Modification of a mendelian ratio by altering the conditions of pollen-tube growth. R. A. Brink, University of Wisconsin. Lantern. (10 min.)
112. Daily variation in crossing-over in maize. L. J. Stadler, University of Missouri. Introduced by H. D. Hooker, Jr. Lantern. (8 min.)
113. Factors influencing the rate of crossing-over in maize. G. N. Collins, U. S. Department of Agriculture. (10 min.)
114. The inheritance of quantitative characters. Karl Sax, Maine Agricultural Experiment Station. (10 min.)
115. Three new Diptera suitable for experimental work in genetics. C. L. Turner, Beloit College, Beloit, Wisconsin. Lantern and exhibit. (10 min.)
116. The salmon-eyed gene in guinea-pigs. H. L. Ibsen and P. W. Gregory, Kansas State Agricultural College. Lantern. (10 min.)
117. New data showing aberrant ratios in the *E* allelomorphic series in guinea-pigs. H. L. Ibsen, Kansas State Agricultural College. Lantern. (15 min.)
118. Inheritance of hypotrichosis in rats. Elmer Roberts, University of Illinois. Lantern. (10 min.)
119. On the number of corpora lutea produced at successive pregnancies by normal and heavily alcoholized mice. E. C. MacDowell and E. M. Lord, Station for Experimental Evolution. Lantern. (10 min.)
120. The occurrence of an eye and a tooth abnormality in a line of albino rats. Elizabeth Jones, University of Maine. (10 min.)
121. Eye defects in the white rat. J. A. Detlefsen, The Wistar Institute. (15 min.)
122. Further data on the inheritance of the sex-linked barred pattern of domestic fowls. L. C. Dunn, Connecticut (Storrs) Agricultural Experiment Station. Exhibit. (10 min.)
123. Genetic and morphological comparison of two kinds of rumplessness in the fowl. L. C. Dunn and W. Landauer, Connecticut (Storrs) Agricultural Experiment Station. Exhibit. (10 min.)
124. Inbreeding with white leghorns with particular reference to egg production. H. D. Goodale, Mount Hope Farm, Williamstown, Massachusetts. Lantern. (10 min.)
125. A sun porch and other equipment for studying the influence of environmental factors on egg production. H. D. Goodale, Mount Hope Farm, Williamstown, Massachusetts. Lantern and exhibit. (5 min.)
126. Linkage relations in the sex-chromosome of the domestic fowl. D. C. Warren, Kansas State Agricultural College. Lantern. (10 min.)
127. The reptilian fowls—A study in atavistic heredity. I. E. Cutler, University of Denver. Lantern. (15 min.)
128. The latitude of genetic indetermination of psychic characters in man, as indicated by a case of identical twins reared apart. H. J. Muller, University of Texas. Lantern and charts. (15 min.)
129. Linkage groups IV and VI in *Drosophila virilis*. C. W. Metz and Mildred S. Moses, Station for Experimental Evolution. Lantern. (10 min.)

130. A comparison of the heterozygotes from reciprocal crosses in the bar series of *Drosophila melanogaster*. A. H. Hersh, Western Reserve University, Cleveland, Ohio.
131. A comparison of the effects of x-ray and temperature on linkage in *Drosophila*. J. W. Mavor and H. K. Svenson, Union College, Schenectady, New York.
132. Some anomalies in *Hadrobracon* and their bearing on maturation, fertilization, and cleavage. P. W. Whiting, University of Maine. (15 min.)
133. A microscopic analysis of genetic characters in *Aplocheilus latipes*. H. B. Goodrich, Wesleyan University, Middletown, Connecticut. (7 min.)
134. Rate of metabolism and sex control in *Cladocera*. A. M. Banta and L. A. Brown, Station for Experimental Evolution. Lantern and charts. (15 min.)
135. Analysis of a right-left gynandromorph of *Colias eurytheme* var. *Alba*. J. H. Gerould, Dartmouth College. Lantern. (15 min.)
136. Genetics of color in the pink and green aphid *Macrosiphum solanifoli*. A. F. Shull, University of Michigan. Lantern. (15 min.)
137. Inheritance of color patterns in the grouse locust, *Telmatettix aztecus* Saussure. R. K. Nabours and Bertha Snyder, Kansas State Agricultural College. Lantern. (5 min.)
138. Chromosomes and sex in *Sciara* (Diptera). C. W. Metz, Station for Experimental Evolution. Lantern and exhibit. (10 min.)
139. A self-fertile strain of *Drosophila* which is partially sterile in outcrosses. H. H. Plough, Amherst College. (10 min.)
140. Chromosome breakage by x-rays and the production of eggs from genetically male tissue in *Drosophila*. H. J. Muller, University of Texas. (15 min.)
141. On the occurrence of mutations within the transplantable cancer. L. C. Strong, St. Stephen's College, Annandale-on-Hudson, New York. Charts. (15 min.)
142. The inheritance of abnormal appendages among the descendants of x-rayed mice. C. C. Little, University of Maine. (10 min.)
143. A possible case of selective fertilization in maize hybrids. R. A. Emerson, Cornell University. Chart. (15 min.)
144. Preliminary announcement of a cytological and a genetical study of *Petunia*. Margaret C. Ferguson, Wellesley College. (7 min.)
145. Hybridism in the quill-worts. E. C. Jeffrey, Harvard University. Lantern. (10 min.)
146. Selection for self-compatibility in five generations of *Brassica pekinensis*. A. B. Stout, New York Botanical Garden. Lantern. (15 min.)
147. Breeding evidence for constant chromosomal types among wild races in *Datura*. A. F. Blakeslee, Gordon Morrison, and Betty P. Watt, Station for Experimental Evolution. Lantern. (15 min.)
148. The trivalents of different classes of $2N + 1$ *Daturas*. John Belling and A. F. Blakeslee, Station for Experimental Evolution. Lantern. (10 min.)
149. New flower colors in *Oenothera* and their genetical behavior. G. H. Shull, Princeton University. Lantern. (15 min.)
150. The inheritance of typical, tufted, and polycladous characters in *Sphaerocarpos*. C. E. Allen, University of Wisconsin. Lantern. (15 min.)

151. The effect of x-rays on rats. Laurence H. Snyder, State College, Raleigh, North Carolina.
152. The nature of the factors which determine shape. Edmund W. Sinnott, Connecticut Agricultural College.
153. Inheritance of color patterns in the grouse locust, *Telmatettix aztecus* Saussure. Robert K. Nabours and Bertha Snyder, Kansas State Agricultural College.

EXHIBITS

1. Photoceptor cells in the earthworm, *Lumbricus terrestris*. Walter N. Hess, Johns Hopkins University and DePauw University.
2. Aberrant secondary sexual characters in crayfishes. C. L. Turner, Beloit College.
3. Cultures of normal and notch-winged mutant specimens of *Leptocera fontinalis*. C. L. Turner, Beloit College.
4. Sex differentiation in *Rana catesbeiana*. W. W. Swingle, Yale University.
5. A mechanism in ciliated epithelia of the gills of lamellibranch molluscs by which ciliary movement may be coordinated. Caswell Grave and F. O. Schmitt, Washington University.
6. Wooden Ruvettus fishhooks from the South Seas. E. W. Gudger, American Museum of Natural History.
7. Rate of growth of certain sessile organisms: *Bugula*, *Balanus*, *Teredo*, *Hydroides* and *Molgula*. B. H. Grave, Wabash College.
8. Physiology of coloration in butterflies of the genus *Colias*. Photographs and specimens. John H. Gerould, Dartmouth College.
9. Drawings of new parasites of Bermuda Echinoidea. Ruth Jane Ball, University of Vermont.
10. Germ-glands of gynandromorph frog. H. V. Neal, Tufts College.
11. Cytological investigations in *Oenothera*. R. E. Cleland, Goucher College.
12. Cultures of normal and notch-winged mutant specimens of *Leptocera fontinalis*. C. L. Turner, Beloit College.
13. Bones of rumpless and normal fowls. L. C. Dunn, Connecticut (Storrs) Agricultural Experiment Station.
14. Samples of feathers of several types of barring in fowls. L. C. Dunn, Connecticut (Storrs) Agricultural Experimental Station.
15. A sun porch and other equipment for studying the influence of environmental factors on egg production. H. D. Goodale, Mount Hope Farm, Williamstown, Massachusetts.
16. A moving model of mitosis and segregation, for use in the teaching of genetics. H. J. Muller, University of Texas.
17. Chromosomes of *Sciara* sp. C. W. Metz, Station for Experimental Evolution.

ABSTRACTS

GENERAL AND COMPARATIVE PHYSIOLOGY

1. *Some factors which influence the nature of after-nystagmus in the white rat.* (15 min.) J. A. DETLEFSEN, The Wistar Institute.

After-nystagmus, as measured by the length of time during which ocular movements persist following twenty turns on a cyclostat in ten seconds as a unit stimulus, is a variable which is influenced by several measurable conditions such as, a) age and, b) labyrinth infection.

a. Age: There is a negative correlation between after-nystagmus and age, with non-linear regression; $r = -0.38 \pm 0.014$ and $n = 0.48 \pm 0.013$. Constants were determined on a basis of 1681 first cyclostat tests on animals without previous rotational experience.

b. Infection: When the right labyrinth is infected we find mean after-nystagmus following clockwise stimulus about normal, but following counter clockwise stimulus it is very short. When the left labyrinth is infected we obtain the identical numerical constants, but in mirror image. The constants were determined by 986 cyclostat tests on seventy-two cases of infected labyrinth. When both sides are broken down by infection, there is no ocular after-nystagmus.

2. *The specificity of hemolytic antibodies.* (10 min.) ROSCOE R. HYDE, Johns Hopkins University.

It is commonly stated that the hemolytic antibody resulting from the immunization of one species of animal with the red corpuscles of another species is specific for the antigen employed in the sense that the antibody reacts with that antigen to the exclusion of all others. We have found, however, that the red corpuscles from the chicken on intravenous injection in the rabbit incites the production of a hemolytic sensitizer as potent for the red cells of the sheep and goat as for the antigen used in its production. This fact makes it possible to show that the specificity of an immune hemolytic sensitizer for sheep corpuscles is determined by: 1) the kind of antigen used in its production; 2) the kind of animal in which it is produced, and, 3) the kind of complement employed in its reactivation in the sense that the first two properties determine its behavior toward different complements. Any statement that defines the specificity of a hemolysin exclusively in terms of the antigen used in its production is misleading. Our result has an important bearing in another direction, for the antibody here produced is of heterophile nature. It is characterized by: 1) a marked hemolytic activity for sheep cells; 2) a high absorption rate; 3) a marked affinity for boiled sheep cells, and, 4) a primary toxicity for guinea-pigs.

3. *Structure and locomotion in Amoeba proteus.* (Lantern; 15 min.) S. O. MAST,
The Johns Hopkins University.

Amoeba proteus contains a central elongated fluid portion (plasmasol), a rigid layer surrounding this (plasmagel), and a thin elastic surface layer (plasmalemma). The plasmagel consists of an outer hyaline layer containing small particles, and an inner granular layer containing small and large particles. There is marked brownian movement in both layers indicating vacuoles containing fluid.

The plasmasol is hypertonic; the plasmagel and the plasmalemma are semi-permeable. This results in excess inflow of water and stretching of these layers until their strength equals the diffusion pressure. When a pseudopod is formed the inner granular layer of plasmagel liquefies locally and the outer hyaline layer softens. This produces a local decrease in the strength of these layers which consequently stretch in this region forming a protuberance (pseudopod). As this is formed there is contraction, especially at the posterior end, resulting in forward movement of the plasmasol which strikes against the inner surface of the hyaline plasmagel at the tip of the pseudopod pushing it against the plasmalemma. The plasmalemma, being attached to the substratum and to the adjoining plasmagel, but not elsewhere, slides forward over the plasmagel above, and remains stationary below resulting in a rolling movement which is, however, confined to the plasmalemma. In free pseudopods the plasmalemma is merely stretched out. Movement in it is consequently equal on all sides.

The plasmasol gels at the tip of the pseudopod, forming hyaline plasmagel, and a little farther back, forming granular plasmagel, both of which solate at the posterior end forming plasmasol.

4. *The relative susceptibility to x-rays of the eggs and sperm of Arbacia.*
(By title.) JAMES W. MAJOR and DAVID M. DEFORREST, Union College.

Eggs and sperm of the sea-urchin, *Arbacia punctulata*, were exposed simultaneously to the same x-ray treatment and subsequently the x-rayed eggs were fertilized by untreated sperm and untreated eggs were fertilized by x-rayed sperm. The untreated eggs and sperm were from the same sea-urchins as the x-rayed eggs and sperm. The x-ray treatment was given with a standard Coolidge tube at 50,000 volts, 2.5 and 3.0 milliamperes at a distance of 25 cm. from the target. The time of exposure varied from five to sixty minutes.

Cultures from the control and x-rayed germ cells were observed after forty-eight hours and the larvae assigned to stages as follows: 1) up to the blastula; 2) gastrula; 3) gastrula which has become triangular and shows the beginning on the two longer arms; 4) arms have developed but are appreciably shorter than rest of the body; 5) arms are approximately the same length as rest of body; 6) arms are longer than rest of the body. One hundred larvae were examined from each culture and the average stage of their development determined.

The results show the following: 1) In the case of all the doses used, even the smallest (3 M.A., 5 min. 25 cm.) there was a retardation of the development; 2) the amount of retardation increased with the dose, being greatest for the largest dose (2.5 M.A., 60 min. 11 cm.); 3) for the same treatment the amount of retardation is always greater when the sperm are x-rayed than when the eggs are x-rayed.

5. *The ability of termites to live perhaps indefinitely on a diet of pure cellulose.* (5 min.) L. R. CLEVELAND, National Research Council Fellow, Johns Hopkins University.

Whatman filter-paper no. 43, which had been extracted in hydrochloric and hydrofluoric acids and in ether, has been fed the large Pacific-coast termite, *Termopsis nevadensis*, and the Eastern termite, *Reticulitermes flavipes*, for eighteen months without the slightest sign of malnutrition. Growth and reproduction have occurred with the same rapidity as in the wood-fed controls. More than 10,000 termites have been used in the experiments. In some cellulose-fed artificial colonies which contained ten adult individuals in the beginning (eighteen months ago) more than 200 half-grown individuals are now present. Thus, the weight of these colonies on a cellulose diet has increased more than forty times.

6. *The effect of temperature on rate of embryonic development of certain Orthoptera (grasshoppers).* (Lantern; 15 min.) JOSEPH HALL BODINE, University of Pennsylvania.

This paper is based on a quantitative study of the effects of temperature on the rates of development of the eggs of several species of grasshoppers. The following conclusions are given: 1) The rate or velocity of development of eggs of certain Orthoptera (grasshoppers) is affected by temperature, and other factors being constant, this rate increases in direct proportion to the increase in temperature within the normal limits of development. 2) Exposures to low temperatures produce an accelerative effect on subsequent development of eggs at constant high temperatures. 3) Protoplasmic rhythms in susceptibility to low temperatures seem to occur in eggs. 4) It is possible to calculate the time of hatching of eggs if previous temperature history be known.

7. *Heat production by the echinoderm egg during fertilization and early cleavage.* (15 min.) C. G. ROGERS and K. S. COLE, Oberlin College.

The authors, by means of a micro-calorimetric method, have measured the heat production of the eggs of *Arbacia punctulata* before, during, and following fertilization through the eight-cell cleavage stage. It was found that the rate of heat production at the instant of fertilization is ten to twelve times that of the unfertilized egg. After fertilization the rate of heat production decreases constantly for about twenty minutes, when it reaches a value of about 65 per cent of that immediately following fertilization, and remains constant thereafter until the passage of the first cleavage plane, at about fifty minutes after fertilization. At the first cleavage the rate drops suddenly by more than 10 per cent, and then remains constant until the eggs are in the eight-cell stage, which is as far as the work has been carried. The rate of heat production of the unfertilized eggs was found to be about 0.08 calories per hour per million eggs, and that of the fertilized eggs, about 0.52 calories per hour per million eggs after the one-cell stage. The energy liberated is approximately one erg per egg per hour.

8. *Rate of growth and age of sexual maturity of certain sessile organisms.* (Demonstration; 10 min.) B. H. GRAVE, Wabash College.

Data are given on the rate of development of Bugula, Teredo, Hydroides, Balanus, and Molgula.

Teredo and probably also all the other molgula become sexually mature in their first season. A specimen of molgula six weeks old shows well-developed gonads.

Wooden structures placed in the water on July 16th contained sexually mature Teredos on August 28th. Their burrows at the latter date measured from $1\frac{1}{2}$ to 2 inches in length. Teredos normally fill their burrows, but contract considerably when removed from the wood. The animals mentioned above measured from $\frac{3}{4}$ inch to 1 inch after removal. Teredo larvae which attach themselves about September 1, 1923, were sexually mature late in June, 1924. This was true also of Hydroides although neither had reached any considerable size. Balanus was sexually mature in one year and had reached average size, although Balanus undoubtedly continues to grow during the second year.

The rate of development of all these animals is surprisingly rapid when the minute size of their swimming larvae is considered. Spiles of piers and hulls of ships that lie at anchor become foul in a few weeks from the growth of sessile organisms. The rate of growth in these species is shown in the form of an exhibit of preserved specimens.

9. *Periodic reversal in direction of heart beat in the chrysalis of Colias.* (Lantern; 15 min.) JOHN H. GEROULD, Dartmouth College.

The heart beats forward in the caterpillar until the approach of pupation. Then a short backward phase alternates with a longer forward phase. During pupation a long phase of double action, forward from the third, backward from the fourth, abdominal segment, alternates with a phase of forward peristalsis. A few hours later, the double action becomes limited to a few (twenty-five) seconds, followed by complete reversal. Except during pupation, when the phase of double action is inordinately long, the proportion in the length of the backward to the forward phases increases with age up to about forty-eight hours. Thereafter a decrease in the relative length of the backward phase and a slackening in rate occur. In the oldest chrysalis with visible pulse, a long forward phase alternated, after a complete rest of several minutes, with a very brief backward action. The rate of beating backward is regularly about half that of beating forward, but the proportion of backward beats to forward changes and much individual variation occurs in the number of beats in a phase.

Reversal of heart beat is an important feature of metamorphosis connected with the rapid development of the wing buds and constriction of the base of the abdomen. Increased blood pressure relieves itself either by complete direct reversal of peristalsis or by intermittent expulsion of haemolymph backward through the thoracic sinuses into the base of the abdomen and up into the pericardium at the 3-4 abdominal segments, resulting in double action.

10. *Some physiological actions of cyanides.* (10 min.) JOSEPH HALL BODINE,
University of Pennsylvania.

1. The physiological actions of HCN and its salts appear to be due, *a*) to the ease with which HCN molecules penetrate living cells and then ionizing, exert their influence by means of H ions and CN ions; *b*) to the weakness of HCN as an acid, which permits at neutrality or at even slight alkalinity the presence of a considerable amount of free HCN molecules in the presence of their salts; *c*) to specific effects occasioned by its chemical activity.

2. The order of resistance of various protozoans to HCN resembles that of the same protozoa to CO₂ and H₂S, but is the reverse of their resistance to mineral acids.

3. HCN in acid, neutral, or slightly alkaline media produces intracellular acidity because of the rapid penetration of HCN molecules into the cells.

4. HCN acts specifically on certain species of protozoa, the order of resistance of *Paramecia* being *Paramecium caudatum* > *Paramecium multimicro-nucleatum* > *Paramecium aurelia* > *Paramecium bursaria*.

11. *Respiration in the tissues of mollusks in relation to age.* (By title.)
H. S. HOPKINS, Iowa State College.

The amounts of oxygen absorbed by the excised adductor muscles of *Venus mercenaria* and of *Pecten irradians* were measured directly, using the micro-respirometer of Thunberg. Blocks of muscles were washed in sea-water and suspended in air in the apparatus. The values representing oxygen consumption were from readings taken after the first hour, and thus indicate the basal respiration in the resting muscle. The oxygen used by blocks of tissue of similar dimensions is proportional to their surface area, rather than their mass, suggesting that oxygen is utilized mainly at the surface. The results calculated from the surface formula ($O/W \frac{1}{2}$) are fairly constant for tissues taken from animals of the same size. They are higher for the muscles of small animals than for those of large ones.

A definite correlation between size of animal (shell length) and the number of seasonal rings of growth on the shell has been established in *Venus*. Assuming these to be annular rings, it appears that the tissue metabolism is inversely proportional to age, being high in young animals (two to five years), and falling off nearly one-third in old individuals (over ten years old).

The method here used is considered to be free from many of the objections which might be raised against the indirect methods of determining the relative metabolism in the tissues of animals intact, in that modifying factors—the influence of the nervous system, the blood supply, and of hormones—are largely eliminated.

12. *Respiratory differences along the axis in Grantia and Tubularia.* (By title.)
LIBBIE H. HYMAN, University of Chicago.

A number of tests were made of the rate of oxygen consumption and carbon-dioxide production per unit weight of apical and basal halves of the body of the sponge *Grantia* (osculum and base discarded). In the majority of cases (about 80 per cent) the apical pieces were found to respire at a more rapid

rate than the basal pieces. In some cases the rate was equal and in one case the reverse condition obtained.

The rate of oxygen consumption per unit volume was determined for apical and basal halves of distal portions of the stem of *Tubularia*. In all cases (nine experiments, eight stems in each experiment) the respiration of the apical pieces was markedly greater than that of the basal pieces.

These experiments constitute further proof of the existence of metabolic axial gradients.

13. *Effects of different tensions of carbon dioxide on certain Orthoptera (grasshoppers)*. (15 min.) JOSEPHINE WILLIS McNABB, University of Pennsylvania. (Introduced by Joseph Hall Bodine.)

This paper is based upon a quantitative study of the resistance of the grasshopper to different tensions of carbon dioxide, noting particularly the muscular movements displayed under the influence of the gas, the rate of recovery from its effects, and respiratory changes in an enclosed space, as measured by carbon-dioxide and oxygen changes. The summary and conclusions are as follows:

1. It appears that exposures of *Melanoplus differentialis* and *Melanoplus femurrubrum* to a stream of pure carbon dioxide for various lengths of time up to about thirty to forty minutes produce reversible effects. Further, the time to the first movement and to recovery after short exposures seems to be independent of the length of exposure. Longer exposures to the gas require longer periods for recovery.

- It follows that the rate of the first movement and of recovery per minute exposure to the gas, up to thirty- to forty-minute exposures, decreases rapidly. Above this limit the decrease in rates is imperceptibly gradual or remains constant until the exposure is sufficiently long to kill.

2. At five to twenty-four hours' exposure to pure carbon dioxide, the animals are irreversibly affected and die. They may or may not exhibit reflexes upon removal from the gas.

3. Characteristic behavior due to the influence of carbon dioxide is exhibited.

4. There are three interdependent factors influencing the exchange of gases between the animal and the air in an enclosed space, namely, the original per cent of carbon dioxide, the original per cent of oxygen, the original ratio of carbon dioxide to oxygen.

14. *Metabolism during embryonic development of eggs and metamorphic changes of pupae of insects*. (Lantern; 15 min.) DAVID E. FINK, University of Pennsylvania. (Introduced by J. H. Bodine.)

The rates of metabolism as measured by the oxygen consumption and CO_2 output were obtained from insects belonging to five orders, e.g., Coleoptera, Diptera, Hemiptera, Hymenoptera, and Lepidoptera. The outstanding results of the work indicate a general marked similarity with respect to metabolic rates during embryonic development of the eggs and during metamorphic changes of the pupae. Marked specific and sex differences are evident. In general, a low respiratory quotient occurs during development, and a high CO_2 output and oxygen consumption during the last stages of development.

15. *The regulation of body volume in fresh-water organisms.* (Lantern; 15 min.)
EDWARD F. ADOLPH, The Johns Hopkins University.

Organisms which live in fresh water are never in true concentration (osmotic) equilibrium with their environment. Why does water not enter to dilute the body fluids? Frogs, earthworms, and flatworms have been studied.

If the internal concentration is raised, water enters the body during the course of several hours, attaining a balance which depends upon the osmotic pressure exerted by the injected substance. If the external concentration is raised considerably, water leaves the body at a similar rate. The concentration balance which is reached in four to twenty-four hours has been found for any internal and any external concentration. The water content of the body therefore changes readily so as to produce a particular balance of concentrations.

The new balance changes slowly, however, toward a restoration of the original body volume. On returning animals from a salt solution to fresh water, the original body volume is not regained at once, but is regained during the course of several weeks.

The volume changes demonstrated are due to the properties of the epidermis. It regulates the concentration of water; it also regulates the concentration of each dissolved substance in the body fluids, so that each bears a normal ratio to every other. Thus the body volume is regulated in accordance with the set of the permeability mechanism of the integument; it is only one of the regulations of concentration similarly performed.

16. *A new index to the function of coloration in fishes.* (Lantern; 15 min.)
W. H. LONGLEY, Goucher College.

To say that two-thirds of Tortugas fishes are changeable in coloration is approximately correct. The colors of these fishes in general repeat those of their environment, and the changes they undergo are upon the whole clearly effective in reducing their conspicuousness as they move from place to place. This has been considered proof that in spite of the occurrence of brilliant hues in some species they are colored for concealment.

A study of color patterns on the eyes of fishes affords a new index to the function of color in the group. Precision of adjustment, elaboration of detail, and apparent utility mark these selected patterns, whose common effect is to mask eye movements. So inferences from the physiological and morphological study of the coloration of a leading group of vertebrates are in complete accord.

This fact seems to the writer to be of genuine importance in theoretical biology, for it appears that many biologists underrate the extent to which adaptation to environment is a peculiarity of organic structure and behavior, and hence magnify the importance of variation in determining the character of existing faunas and floras.

17. *Physiology of the color pattern in butterflies of the genus Colias.* (Lantern; 15 min.) JOHN H. GEROULD, Dartmouth College.

The melanic border and discal spot of the fore wing are anticipated in the wing bud of the fresh pupa by a row of submarginal permeable cuticular pits occupying 'cells' but immediately superficial to the submarginal bundle of

trachioles of the larval wing bud. A central pit lies in front of the future black discal spot at the terminus of a bunch of trachioles. These cuticular pits blacken by oxidation soon after pupation. Oxidation of the scales of border and discal spot occurs much later, but extends from each pit inward toward the middle of the wing, the submarginal areas of melanic pigmentation fusing to form the border. Many Pieridae have a black stigma confluent anteriorly with the discal spot, probably originating beneath a central pit. Temperature, sex, and genes (multiple factors) control the extent of oxidation. Its progress is checked at various stages in winter-bred individuals and in subarctic species. Hence I undertook to suppress it by blocking the pits with beeswax immediately after pupation. The melanic markings were not suppressed, but the fore wing was generally reduced in size as compared with the other, untreated wing. Oxygen for the reaction ($\text{tyrosin} + \text{tyrosinase} + \text{O} = \text{melanin}$) comes from the thorax, but CO_2 probably escapes from the pits, for metabolism was impeded by blocking them. Black scales of the border do not develop melanin until after yellow (ground color) scales are mature. Melanin may be simply an oxidized respiratory pigment. It is formed when metabolism slows down, especially under low temperature.

18. *Seasonal changes in melanic pigmentation in butterflies of the genus Colias.* (Lantern; 10 min.) JOHN H. GEROULD, Dartmouth College.

Width of the melanic border and size of the 'discal spot' are diminished in winter-bred individuals—an index of diminished oxidation and respiratory activity in the wing bud of the chrysalis. In this case the oxygen comes into the pupal wing bud from the thorax. On the other hand, the proportion of melanic scales on the undersurface of the hind wings and apices of the fore wings under winter conditions is greatly increased. This oxidation is promoted by the thinness of the membranous diaphragma separating the undersurface of the wing bud from the underlying air cavity, allowing oxygen to come into close contact with the surface of the scales. The amount of melanin deposited in these scales varies inversely with temperature. Little or no melanin is developed beneath the wings of butterflies bred in midsummer, except in certain strains in which special hereditary factors have a controlling effect in melanin production. Likewise, in certain strains of caterpillars of *Colias eurytheme*, two dorsolateral rows of melanic spots appear in winter-bred caterpillars, but are never seen in the same stock or in any stock bred in summer.

19. *The process of awakening from hibernation in the thirteen-lined ground-squirrel (Citellus tridecemlineatus).* (Lantern; 15 min.) GEORGE EDWIN JOHNSON, Kansas State Agricultural College. (Introduced by Robert K. Nabours.)

The process of awakening from hibernation in the species considered involves a marked increase in metabolism. During a recovery from very deep lethargy the body temperature may rise from $2^{\circ}\text{C}.$ to above $30^{\circ}\text{C}.$, inspirations may increase from one per minute to about 150 per minute, and the pulse rate may rise from 13.5 per minute to about 300 per minute. This process may require an hour or more in a very torpid ground-squirrel. The opening of the eyes, which may be taken as the waking-point, is found to occur within wide temperature limits. The

waking phenomenon may be induced in a cold room by disturbing the animal, as by lifting it up and placing a thermometer into its food pouch. No outward response to this stimulus may be seen, but the temperature and pulse records prove that the metabolism is rising—slowly at first, but with increasing rate as the point of waking is approached. The period of waking may be shortened by transferring the torpid animal to a warm room, in which case the temperature rises very rapidly at first, then more gradually, and again more rapidly near the time of waking. The anterior part of the body recovers from lethargy earlier than the posterior part. Hibernation may be produced by artificial cold temperatures during any season of the year. Below-freezing room temperatures may prove fatal to torpid ground-squirrels.

20. *Photoreceptors of the earthworm, Lumbricus terrestris, with special reference to their distribution, function, and structure.* (Demonstration; 15 min.)

WALTER N. HESS, The Johns Hopkins University and DePauw University.

A special type of cell, called 'Lichtzelle' by Hesse, was found in the photosensitive regions of the earthworm, but not in the non-photosensitive regions. Wherever the epidermis of the organism is most sensitive to light, these cells are most abundant. They are found in the epidermis of all body segments and also in nerve enlargements of the prostomium and caudal segment, but the intersegmental and ventral regions of the different segments, except the more distal ones, both anterior and posterior, contain none of them. They are supplied by nerves and each of them contains a characteristic inner structure, the optic organelle, composed of a large central hyaline structure, the lens, which is surrounded by a dense network of nerve fibrillae, the retinella. When viewed in hanging-drops the lens was found to focus light in the region of the retinella irrespective of the direction of the rays.

These cells are similar in structure and function to the visual cells in leeches. These data, as well as those given above, all indicate that they function as photoreceptors and that the fibrillae of the retinella are the direct receptors of light stimuli.

21. *The relation between illumination and the stimulating efficiency of intermittent light of different ratios between the duration of the flashes and the dark periods.* (Charts; 15 min.) WILLIAM L. DOLLEY, JR., Randolph-Macon College, and S. O. MAST, Johns Hopkins University.

It has been shown previously that the effect of intermittent light may be equal to, greater than, or less than that of continuous light of equal illumination, and that this effect depends upon the luminous intensity, the flash frequency, and the ratio between the duration of the flashes and the dark periods of the intermittent light.

These experiments indicate that in the drone-fly, *Eristalis tenax*, the ratio between the duration of the flashes and the dark periods of intermittent light of maximum effect in weak light is not the same as it is in strong light. The results of these experiments are thus in harmony with those previously described and lend further confirmation to the theory of Mast that the processes involved in stimulation are not continuous, that there are in the nervous system or the photo receptors of insects alternate sensitive and refractory periods, stimulation occurring during the former and restitution during the latter.

22. *Reactions of the cyprid larvae of barnacles to spectral colors.* (10 min.)
J. PAUL VISSCHER, U. S. Bureau of Fisheries. (Introduced by S. O. Mast.)

A study of the reactions of the cyprid larvae of *Balanus eburneus* and of *Balanus amphitrite* shows that spectral colors of equal energy values have different stimulating efficiencies. Light in the field of green and blue-green was found to have the optimal stimulating values. For both of the species of barnacles which were studied the relative values were approximately equal.

23. *Modifiability in behavior in honeybees.* (15 min.) BRUCE LINEBURG, Lake Forest College. (Introduced by S. O. Mast.)

Bethe, A. ('98), writes: "It seems to me that these insects (honeybees) have no ability to make experiences and by them to modify their actions."

Kellogg, V. L. ('03), concludes that "it seems obvious" that the issuance of a swarm of honeybees "depends upon a sudden extra-development of positive heliotropism."

Loeb, J. ('18), asserts that certain animals are compelled to bend or move automatically either to a source of light or away from it. He also asserts that the mating of ants "is a heliotropic phenomenon," and that observations have been made "which show that the nuptial flight in bees is also due to an outburst of positive heliotropism."

In 1922 the present writer constructed an observation hive having one side of glass and an exit, darkened by means of a maze, at the opposite side. An electric lamp continuously lighted the glass side of the hive. When first placed in the hive, large numbers of workers sought an exit toward the light; later, however, none attempted to leave the hive by way of the glass side, but went out at the opposite side. Three queens have been mated from this observation hive.

These observations lead one to conclude that: 1) bees may modify their actions through experience; 2) that a honeybee is not compelled to move to or away from a light, and, 3) that mating in honeybees is not dependent upon a positive photic response.

24. *The relation between the responses to mechanical shock and to sudden increase in illumination in Amoeba proteus.* (15 min.) HARRY T. FOLGER, University of Michigan. (Introduced by A. F. Shull.)

The response which *Amoeba* gives both to mechanical shock and to sudden illumination consists of a cessation of movement, which does not take place immediately on stimulation, but after an appreciable interval. This interval, the reaction time, consists of a time during which the stimulus is acting, the stimulation period, and a time during which it may not be acting, the latent period. The reaction time depends upon the magnitude of the stimulus, becoming longer as the intensity of the stimulating agent is increased. After sudden illumination or after mechanical shock, the amoeba remains quiescent for some time, and the duration of this period likewise depends upon the intensity of the stimulating agent, being longer after a strong stimulus than after a weak one. This similarity leads one to infer that fundamentally the responses to sudden illumination and to mechanical shock are the same.

There is, however, even more conclusive evidence. When an amoeba has been suddenly exposed to light it is necessary that a certain amount of time elapse for its recovery from the effects of the shock before it will again respond to sudden illumination. Likewise, after a mechanical shock the amoeba must be allowed time for recovery before it will respond to a second shock. But it has also been found that after a response to light, time must be allowed for recovery before the amoeba will react to mechanical shock, and vice versa, indicating strongly that the responses to the two forms of stimuli are essentially the same.

25. *Metamorphosis to the dissoconch stage without attachment in the veligers of Ostrea and of Mytilus.* (Lantern; 15 min.) THURLOW C. NELSON, Rutgers University.

Metamorphosis in bivalve larvae with cessation of a pelagic existence involves loss of the velum and in the *Monomyaria* disappearance as well of the foot and anterior adductor muscle. Mature oyster larvae obtained from plankton catches were suspended in a fold of bolting-cloth in an aquarium where in the course of a week approximately 5 per cent underwent metamorphosis without attachment and began rapidly to secrete dissoconch shell. In the absence of a substratum, the right valve grew down and over the left valve eventually enclosing it as in a hemispherical cowl. Death occurred in all cases before reaching a diameter of 0.5 mm. That this process may occur rarely in nature is shown by a dissoconch of similar appearance, taken in a plankton sample, July 11th, in Barnegat Bay, New Jersey. The oyster measured 0.684×0.494 mm. over all, the larval shell being 0.3×0.277 mm.

In *Mytilus edulis* transformation from the prodissoconch to the dissoconch occurs normally in all individuals while still pelagic, the purple shell of the dissoconch contrasting sharply with the yellow color of the larval shell. With the loss of the velum the young mussels secrete gas from the gills which, gathering into a large bubble in the branchial chamber, enables the bivalve to float about until carried to a spot where attachment by the byssus may be effected. The larvae of *M. recurvus* do not show pelagic dissoconchs. The bearing of this adaptation on the wide distribution of *Mytilus edulis* is discussed.

26. *The experimental production of osteoclasts in the femur of the frog.* (Lantern; 10 min.) H. E. JORDAN, University of Virginia.

Under normal conditions, the femoral marrow of the adult frog contains only very few or no multinucleated giant cells. Under experimental conditions, involving total splenectomy (Jordan and Speidel, '24), such giant cells become very numerous. They are located peripherally and arise chiefly by fusion of hemoblasts, with minor secondary stromal additions. In the femoral marrow of the early postlarval stages similar osteoclasts and chondroclasts arise chiefly by fusions of stromal (mesenchymal) cells, in part also by fusions of osteoblasts. The apparent contradictions in the described modes of origin of osteoclasts find a ready reconciliation on the basis of a close genetic relationship between young mesenchymal cells (reticulum), hemoblasts, lymphocytes, osteoblasts, and young endothelial cells. All of these cells may assume phagocytic activities, enhanced under conditions of fusions. The great abundance of osteoclasts in the femoral

marrow of the splenectomized frog and their origin from hemoblasts may be interpreted thus: Splenectomy removes the chief organ of hemopoiesis in the frog. In a few specimens the operation stimulates a compensatory development of hemopoietic marrow in the long bones, chiefly the femurs. Stromal cells become largely used up in the genesis of hemoblasts. The larger medullary space required by the necessary amount of hemopoietic marrow demands the action of osteoclasts which, in the almost complete absence of stromal cells, arise from the available least differentiated cells, namely, the hemoblasts.

27. *Experimental regression and redevelopment in *Corymorpha palma*.* (15 min.)
C. M. CHILD, University of Chicago.

The *Corymorpha* planula does not swim, but remains in contact with the substratum and the hydranth develops directly from its apical end, not by budding from the original basal end, as in campanularians. The young hydroids, three to six days old, < 1 mm. to 3 mm. in total length, with hydranth body, mouth, proximal and distal tentacles, stem and basal region already differentiated, undergo regression when subjected to the action of various agents. Thus far regression has been induced by ethyl alcohol, 2 to 2.5 per cent; HCl, pH 6 to 6.5; LiCl equivalent of m/25, all made up in sea-water. After forty-eight to sixty hours, tentacles are more or less completely resorbed, apparently without loss of cells, the mouth has disappeared, the hydranth has decreased in size and become rounded. The naked portion of the stem, if already present, may also undergo reduction. Continued exposure to the agent (four to five days), with perhaps slight increase of concentration, determines further regression to forms resembling the later, and in some cases even the earlier planula. These regressive forms differ from corresponding stages of progressive development chiefly or only in relatively smaller size of apical and larger size of basal regions—a consequence of differential susceptibility along the axis.

After return to sea-water, recovery and repetition of progressive development with normal differentiation have been observed repeatedly in all except the most extreme degrees of regression, and even in these some progression may occur, exhaustion of nutritive reserves being apparently the limiting factor.

28. *Inhibiting agencies in ontogeny and regeneration.* (15 min.) HERBERT W. RAND, Harvard University.

In Herbst's 'formative stimuli,' Child's 'physiological dominance,' and Spemann's 'organisators,' the common underlying conception is that of some agency which is positively active in determining, initiating, or controlling development. There is steadily increasing evidence that an important rôle in development is played by agencies which act as a check upon growth or prevent duplication of structures—inhibiting agencies.

Experimentation (by the author or under his direction) involving various combinations of amputation and transplantation operations on *Hydra* and *Planaria* shows that any one of the more or less specialized regions of these animals may inhibit regenerative development of a similar region. A head inhibits development of another head, a tail inhibits tail development. The effectiveness of this inhibition varies in some inverse relation to the distance of the inhibiting

region from the wound surface. Given a cut surface at which, following mere amputation, regeneration of a certain set of structures (head, tail, or foot) is to be expected, such regeneration will not take place, provided that, as result of appropriate operative procedure, a similar part (head, tail, or foot) is in good physiological continuity with the tissues of the wound region and at not too great distance from it—nevertheless, in entirely abnormal space relation to it.

As the immediate cause of the initiation of regeneration, therefore, it is not necessary to assume 'formative stimuli,' or a 'wound stimulus,' or other positively acting agency. By mere removal of inhibitions, inherent developmental potentialities may be allowed to become kinetic.

29. The physiological basis of wing production in aphids. (Lantern; 15 min.)

LLOYD ACKERMAN, University of Michigan. (Introduced by A. Franklin Shull.)

When *Rhopalosiphum prunifoliae* was grown under constant temperature conditions the highest percentage of winged forms produced was at high (26°C.) and moderately low temperatures (14° to 16°C.), the lowest percentage occurring at 18°C. At a given temperature succeeding generations show a slow decline in the percentage of wing production until zero is approximated, and the average number of offspring per parent undergoes a similar reduction. The results of previous investigators on the effects of salts, starvation, and type of parent (winged or wingless) were for the most part corroborated. Variations of size, color, number of offspring, number of sensoria, ocelli, and cuticular markings are strongly correlated with the production of wings. A complex emulsion, the internal phase of which consists of at least four different kinds of globules, two of them being pigmented, is found in the body cavity and represents about one-quarter of the total bulk of the aphid. The pigments vary in color with the H-ion concentration. Observations on the characteristics of this emulsion, and comparisons of these characteristics with the changes that occur during the development of the winged form, when taken in conjunction with the general instability of the aphid as a whole as shown by the effects of environmental influences, indicate that the variability of these insects is associated with, and probably the direct resultant of, the instability of the emulsion of the body cavity.

ENDOCRINOLOGY

30. Thyroid adrenal association. (Lantern; 15 min.) FREDERICK S. HAMMETT, The Wistar Institute.

A biometrical study has been made by the method of partial correlation of the weight association between the various excretory organs. It was found that there is a specific positive correlation between thyroid weight and adrenal weight in both male and female albino rats at the usual range of thyroid activity, which is independent of growth factors carried by the total body weight and of influences emanating from the other endocrine glands. The degree of unconditioned association is greater in the male than in the female. When thyroid activity is enhanced above the usual, though not to an abnormal degree, the positive correlation is maintained in the males, but not in the females. The sex differential effect of the gonads and the hypophysis are probable participants in the produc-

tion of this sex difference in association at the higher level. There is no definite correlation between thyroid weight and the weight of any of the other endocrine glands at the usual level of thyroid activity. Therefore, the combination which is reported here is unique and is consistent with the hypothesis of a thyroid-adrenal functional relationship.

31. *The depressant action of thyroxin on cell division.* (Lantern; 15 min.)
HARRY BEAL TORREY, University of Oregon.

Further experiments confirm our former finding of a depressant effect of thyroxin on the division rate of *Paramecium* independent of the food supply and the hydrogen-ion concentration in the medium, to variations in both of which *Paramecium* responds. The depressant action of thyroxin increases directly with its concentration but with decreasing increments. By the addition of sodium hydroxide, Woodruff's well-known beef-extract medium can be used, in concentration two or three times higher than that originally recommended, the advantages of a more abundant culture of bacteria is thus secured and at the same time the hydrogen-ion concentration maintained within satisfactory limits, represented in our experiments by pH 7.4 to 7.8.

32. *The 'retrograde metamorphosis' of the Sirenidae; experiments on the functional activity of the thyroid of the perennibranchs.* (Lantern; 10 min.) G. K. NOBLE, The American Museum of Natural History.

The 'retrograde metamorphosis' which Cope described in the Sirenidae may be produced in both *Pseudobranchius* and young *Siren* in ten days by treatment with iodothyrene solutions of over 0.05 per cent, or in a much longer time by starvation. It differs from gill reduction in other urodele larvae during starvation in that the atrophy of the gills is complete. No other changes accompany this loss of branchiae. It is in no sense a metamorphosis. Recently hatched *Pseudobranchius* and very young *Siren* have well-developed branchiae. All later stages normally possess functional gills.

Neotenus urodeles may be divided into three categories, according to the type of endocrine deficiency: a) neotenus larvae of known metamorphosed species in which the thyroid apparatus has failed to function; b) permanent larvae with rudimentary or absent thyroids; c) permanent larvae with tissues not sensitized to thyroid substances. All members of the last group have well-developed thyroids which are functionally active in that they produce a rapid metamorphosis when fed to *Amblystoma* larvae. Metamorphosis apparently cannot be produced in any member of the last group by methods frequently used to produce metamorphosis in the first category. Attempts to metamorphose recently hatched *Pseudobranchius*, adult *Pseudobranchius*, young and old *Siren*, young *Neoturus punctatus*, and adult *Cryptobranchius* by iodothyrene or thyroxin solutions or by urodele thyroid feeding were unsuccessful. The tissues of *Cryptobranchius*, the Sirenidae, and one species of Proteiidae do not seem to be sensitized to thyroid substances.

33. *Concerning the effect of thyroid constituents on protoplasm in general.* (Lantern; 10 min.) ROBERT A. BUDINGTON, Oberlin College.

In view of numerous instances in which thyroid constituents have been reported as having hastened development and differentiation, especially in animal larvae, i.e., in relatively undifferentiated cell masses, the attempt is here made to find if similar substances provoke a comparable response on the part of plant tissues.

With suggestive results from previous observations on root-tips of *Allium* as a background, *Narcissus* roots were used. Considering the cells just proximal to the root-cap as essentially undifferentiated, measurements were made of the distance from the tip of the root to the differentiated periblem and plerome cells, to ascertain whether or not specialized tissues of the root proper extend down farther into the tip in such roots as have been grown in nutritive media containing thyroid constituents than they do in roots grown in nutritive media alone.

The observations made indicate an affirmative reply to the question implied; from this the suggestion is made that all protoplasm may be similarly affected by thyroid-gland constituents, at least in so far as these latter influence differentiation.

34. *Some factors involved in the metamorphosis of the Colorado axolotl.* (Lantern; 15 min.) W. W. SWINGLE, Yale University.

1. Axolotls metamorphose if fed with thyroid tissue or if repeatedly injected with thyroxin, acetyl thyroxin, iodothyrene, iodized proteins such as serum-globulin, serumalbumen, fibrin, casein, and the amino acid tyrosin. Iodized proteins such as bliadin and edestin are ineffective, but the iodine combination is a loose one.

2. Large quantities of inorganic iodine injected, fed and implanted subcutaneously, induced no changes aside from shedding of the skin and slight bulging of the eyes.

3. Large larvae were thyroidectomized and the gland contents injected intraperitoneally. No metamorphosis occurred.

4. Mature animals were thyroidectomized and the glands plus those of another similar animal were reinjected. Results negative.

5. Large animals were thyroidectomized and the thyroids plus those of two other axolotls reinjected. Two animals metamorphosed; six did not. The amount of hormone injected was sufficient to metamorphose over one hundred thyroidless tadpoles as tested by using similar amounts on such larvae.

6. The thyroids of axolotls in advanced stages of metamorphosis were injected into thyroidectomized animals, each receiving the glands of two animals. Results negative.

7. Thyroids of recently metamorphosed axolotls were injected into thyroidless individuals, each receiving two sets of glands. Results negative.

8. Normal axolotls usually spontaneously metamorphose within a few months following transfer to the laboratory.

It is apparent that the axolotl has active thyroids, capable of inducing transformation, providing the organism is in the proper physiological state. Other factors besides the thyroid are involved in axolotl neoteny—factors involving sensitization of the tissues to the hormone.

35. *Endocrine glands and bilateral symmetry: observations upon fore-limb eruption in frog larvae under treatment with thyroid and thymus extracts.* (Lantern; 15 min.) C. C. SPEIDEL, University of Virginia Medical School.

The bilaterally symmetrical development of the frog larva is affected in a definite way by experimental hyperthyroidism. In normal tadpole metamorphosis the left fore limb erupts before the right fore limb in about 70 per cent of cases. In the case of half-grown tadpoles reared in thyroid solution, however, practically 100 per cent put out the left fore limb first. Of 133 thyroid-treated animals of this kind every one protruded the left fore limb first. If, however, nearly full-grown tadpoles already near the time of fore-limb eruption are treated with thyroid, right fore limbs may erupt first during the first two days; thereafter prior left fore-limb eruption obtains. In other words, an original bias of an animal toward prior right fore-limb eruption may not be changed by thyroid feeding within two days.

The effect of the thyroid is explicable in terms of the original asymmetrical pattern of the respiratory apparatus (i.e., sinistrally located spiracle) coupled with the close anatomical relation of the fore limbs to this apparatus.

With thymus treatment there occurs a greater percentage of tadpoles putting out the right fore limb first, thus reducing somewhat the normal majority in favor of prior left fore-limb eruption.

36. *Factors involved in the formation of the opercular leg perforation in anuran larvae during metamorphosis.* (Lantern; 15 min.) O. M. HELFF, Yale University. (Introduced by W. W. Swingle.)

The fore legs of tadpoles develop beneath the operculum and are released through large perforations resulting from autolysis of the skin. The problem was to determine the following points: 1) Is the autolysis specific for opercular skin? 2) Is the thyroid hormone directly responsible for the autolysis? 3) Is the leg through enzymatic action or mechanical pressure a factor? 4) Are there other factors involved?

1. Specificity of the skin: All skin is capable of autolysis. This was proved by transplanting back and side skin to perforation region. Autolysis and perforations occurred.

2. Action of thyroid hormone: The thyroid hormone has no direct effect, since opercular skin, transplanted to the back, failed to autolyze.

3. Rôle of fore limb: The leg does not initiate autolysis, but can form perforations by mechanical pressure as shown by: a) Limb-bud transplants under back skin. Two perforations formed out of twenty successful grafts. No autolysis present. b) Glass-bead transplants under skin. Large perforations occurred without autolysis.

4. Other factors: Obviously, other structures in the vicinity of the limbs are involved in the formation of the opercular perforation, since the latter occurs despite the absence of limbs and since skin from this area does not autolyze when transplanted elsewhere. The atrophying gills were found to be responsible. This was proved by transplanting resorbing gills under opercular skin grafted on the back, thus producing pronounced and rapid autolysis. The developing limbs merely hasten the formation of the perforation by mechanical pressure.

37. *Extirpation and transplantation of the hypophysis of fish and amphibians.* (15 min.) W. F. DESMOND, Yale University. (Introduced by W. W. Swingle.)

1. The hypophysis was extirpated from *Fundulus* of various sizes; the gland was successfully removed by the oral route, the animals withstanding the operation nicely and appearing to suffer no ill effects from hypophysectomy. No effect upon the pigmentary system was observed, although careful dissection of the fish under a binocular microscope showed no pituitary tissue present in 88 per cent of cases.

2. Normal *Fundulus* were transplanted with the hypophysis of adult fish and frogs—some animals receiving a single gland, others two. The transplants produced no effects upon the pigmentary system. Similar grafts made on pituitaryless tadpoles and hypophysectomized axolotls turned the animals from silvery to dark. The pigment system of *Fundulus*, although highly sensitive to many agents, is not under hypophyseal control as is the case with this system in amphibia.

3. Large axolotls were hypophysectomized, the glands being removed through the mouth. The pigmentary response is the same as that described for tadpoles. The induced color response is apparently permanent, since some of the animals have been kept for eight months without change. Transplants of the anterior lobe of the pituitary of axolotls and frogs into hypophysectomized axolotls and tadpoles produced no effects upon the pigmentary system, but transplants of the posterior lobe including the intermedia darkened the white animals.

4. The hypophysis was removed from two adult *Necturus*. The color response was not striking. The yellow pigment bearing cells expanded, but the melanophores showed little if any change.

38. *Is the adrenal cortex essential for life?* (Lantern; 15 min.) R. L. ZWEMER, Yale University. (Introduced by W. W. Swingle.)

The problem was to determine whether or not the adrenal cortex is necessary for the maintenance of life in cats.

Controls. Total removal of both glands, with a period of one week between operations, gave an average survival of three days in ten cases.

Transplanted cortex. Both glands were removed at seven-day intervals. At the second operation, one-half of the cortex scraped free of medulla was implanted into the rectus abdominalis muscle. The life of the cats so treated was prolonged an average of seven days. The grafts invariably degenerated.

Survival value of single cortex. The blood supply of the left adrenal was clamped and the medulla curetted out, together with a portion of the cortex; the gland was then sutured and replaced. One week later, the right adrenal was removed. Fourteen animals were used. Four kittens survived fifteen to twenty days, finally dying of pneumonia. The remaining ten adults remained perfectly healthy. Five are alive and healthy at the present writing, several weeks after the second operation.

After three weeks, the remaining left cortex was removed from five cats which had shown no symptoms. Four cats showed typical adrenal insufficiency symptoms, dying within a few days.

Histological examination of the extirpated cortical tissue showed no medullary tissue present in three cases; minute amounts were present in two glands. A fifth animal showed no symptoms and was killed. An accessory gland consisting solely of cortical tissue was found at autopsy posterior to the kidney.

MISCELLANEOUS

39. *On the development and encouragement of science instruction in American colleges and universities, 1912-1932, with especial reference to biological science.* (Lantern; 15 min.) N. M. GRIER, Dartmouth College.

This has been studied from the registration and financial statistics of thirty-five institutions, most of them having an endowment of \$1,000,000 or more. Eighteen of the thirty-five show a decrease in the total enrollment in biological subjects.

Detailed analysis of the biological statistics show that in 25 institutions there is a decrease in 12 of the enrollment in zoology (all divisions), with 4 showing no gain. The greatest increase is in Western institutions and the Middle Northern States. Botany, 16 of 27 institutions show a decrease, especially in New England institutions. The greatest increase in botany is in the Southern women's colleges. Ten of 17 show a decrease in physiology and hygiene, the largest enrollments being found in the South, especially in the women's colleges. As regards institutions with the general biology course, 9 show an increase, 7 a decrease, 1 no gain. It is gaining in most of the women's colleges studied, in New England men's and Southern women's colleges. The average percentage of the total enrollments of the institutions for each of the ten years in the above institutions is: all biology, 30 per cent; all chemistry, 32 per cent; all physics, 18 per cent; all geology, 9 per cent; all astronomy, 4 per cent. Divisions of biological science: zoology, 9 per cent; botany, 8 per cent; physiology, 8 per cent. General biology (17 institutions), 13 per cent. The range of cost in all biology per student for supplies and equipment for each of the ten years ranges from \$0.93 to \$15.75—a fact which may have some bearing on the standards of preprofessional courses, half the institutions not receiving the average of \$6.36, which sum may be compared with the laboratory fees ordinarily paid by the students.

CYTOLOGY

40. *The origin of the 'amebocytes with spherules' in Arbacia.* (10 min.) JAMES E. KINDRED, University of Virginia.

From the study of fresh and fixed perivisceral fluid and sections of the intestine of *Arbacia*, the following conclusions have been reached.

1. Food droplets pass from the epithelium of the intestine into the tunica propria where they are ingested by leucocytes, thereby giving rise to amebocytes with hyaline spherules.

2. The hyaline spherules are basophilic in reaction.

3. In the later stages of intracellular digestion the spherules become red and yellow in the living cells and in the fixed material give an acidophilic reaction.

4. The spherules are non-lipoid in character, as evidenced by their failure to react to osmic-acid fumes and their persistence in alcoholic material.

5. Thus the three types of 'amebocytes with spherules' present in the perivisceral fluid of *Arbacia* are accounted for.

41. *Formative cells of planarians.* (Lantern; 15 min.) WINTERTON C. CURTIS and LULA M. SCHULZE, University of Missouri.

In spite of many studies upon planarians, the histological changes during regeneration appear never to have been adequately described. The tissue is difficult to handle and interest has centered upon other aspects of the regenerative process. Observations, made some years ago by the senior author upon the formative cells of the parenchyma in *P. maculata* and which have been confirmed by other investigators, have recently been extended as a comparative study including two other genera, *Dendrocoelum lacteum* and *Phagocata gracilis*. These three species exhibit different capacities for regeneration and show in correlation with their diverse regenerative powers different numbers of formative cells. Approximate counts of the formative cells in each show that these vary directly with the regenerative capacity. For example, the average of our counts for tail pieces of *P. maculata*, formed by normal fission and therefore undergoing a maximum of regenerative growth, gives approximately seventy cells per unit area; of *P. maculata* without indications of recent normal fission forty-five cells per unit area; of *Ph. gracilis*, twenty-two cells, and of *D. lacteum*, fifteen cells. The figures parallel in a general way the regenerative capacities of these forms. In all cases the formative cells seem to be the active elements in the production of new tissue. They divide by mitosis. We find no evidence that amitotic division of the specialized parenchyma nuclei is an important factor in regeneration. The study is being extended to other genera and species and the relation to the axial gradient is under investigation. It may also be noted that the differing habits of reproduction, originally reported by the senior author for the *P. maculata* in four different localities near Woods Hole, Massachusetts, have been confirmed by all our subsequent collecting in these localities.

42. *Giant cells in cultures of amphibian tissues.* (Lantern; 15 min.) GEORGE A. BAITSSELL, Yale University.

Some observations made on two giant cells, which appeared in a culture of frog liver, were recently reported by me (Proc. Soc. Exp. Biol. and Med., 1924, vol. 21, p. 434). Since then some four hundred cultures of amphibian tissues, particularly the heart and liver of the tadpole, have been made and studied in order to learn more regarding the occurrence and activities of this interesting type of cell. In approximately 20 per cent of these cultures giant cells have appeared.

These giant amoeboid mononuclears are noteworthy in a number of ways. The cytoplasm is generally very active, and forms long pseudopodia-like processes which exhibit a great variety of shapes and sizes. The cytoplasm frequently contains inclusions of various sizes which move with the cytoplasmic flow. An inactive cell typically measures about 0.2 mm. in diameter, which is some eight times the diameter of a red blood corpuscle; the latter in turn being much larger than the average tissue cell. Active cells measuring over 1 mm. in length are not uncommon. The cell processes, when they come in contact, tend to flow together to form temporary syncytia. No trace can be observed in such cases of the point of union. Later, when the cells pull apart, the point of

separation does not always appear to be at the original point of union. The cells remain active for several days in the culture medium and appear to be splendidly adapted for various types of microdissection studies.

43. *Intracellular digestion and assimilation in the phagocytic cells of the intestine of Planaria.* (15 min.) B. H. WILLIER, The University of Chicago.

Digestion, assimilation, and storage of food occurs within the phagocytic cells of the intestine of *Planaria dorotocephala*. Food particles in the form of isolated cells and cellular fragments are engulfed into a food vacuole where they coalesce into a granular spherule. The granular spherule then transforms by a gradual process of condensation into a smaller spherule, now composed of a homogeneous, gelatinous, and chromatophilic substance. Both the granular and homogeneous spherules give positive xanthoproteic and Millon reactions for proteins and are negative to the usual fat tests.

The homogeneous protein spherules are converted next into fat-droplets, since the period during which the protein spherules are disappearing exactly coincides with the period of fat formation. These protein spherules apparently dissolve in the cytoplasm—various stages in the process of dissolution being indicated—furnishing intermediate chemical compounds from which the fat is synthesized. At the height of this transformation microchemical tests for such intermediate chemical bodies are made. Certain preliminary tests indicate that, 1) a carbohydrate stage is not found in the transformation of the protein into fat and, 2) fatty acid, a stage in the synthesis of true fats, is present (Nile-blue sulphate).

Fat-droplets, consisting apparently of a mixture of at least true fats and fatty acids, are stored in the phagocytic cells. They remain unchanged in quantity for six weeks of fasting, after which they gradually diminish, but never entirely disappear as long as the worm lives. Fat is apparently an essential constituent for maintaining the physiological integrity of the phagocytic cells.

44. *The maturation divisions and the segregation of heteromorphic homologous chromosomes.* (Lantern or opaque projection; 15 min.) E. ELEANOR CAROTHERS, University of Pennsylvania.

The authors of most papers dealing with the chromosomes at maturation take sides for either pre- or postreduction. But given parasynapsis of morphologically similar split homologues (conditions which usually exist in the Acrididae), it is, obviously, quite impossible to tell which two of the four threads came from a given parent. This difficulty does not exist if the homologues are morphologically unlike.

In *Trimerotropis citrina* and other acridines one or both of the two smallest tetrads may be composed of homologues which are unlike as to size. In *T. citrina* this condition exists in the second smallest tetrad in approximately one out of every seven individuals. The members of this pair usually segregate in the first division, but in roughly 8 per cent of the cases noted segregation occurs in the second maturation. Rarely, this pair fail to synapse, in which case both or either may divide at the first maturation or they may pass to the same or to opposite poles without division which then occurs at the second maturation.

The conclusion is that while a given pair may possess a tendency to segregate at one division in preference to the other this is not a fixed condition. The two maturation divisions are essentially a unit and segregation may occur in either.

45. *The chromosome cycle in the rotifer, Asplanchna intermedia.* (By title.)
DAVID D. WHITNEY, University of Nebraska.

The number of chromosomes in the mature parthenogenetic female-producing egg is fifty-two and in the mature parthenogenetic male-producing egg is twenty-six. The mature sexual egg also has twenty-six chromosomes. The primary spermatocyte cells in the male have twenty-six chromosomes in the equatorial plates. These cells do not divide to form the secondary spermatocytes, but gradually change into the mature spermatozoa. A varying number, however, of the primary spermatocytes divide and each of the resulting daughter cells receive thirteen chromosomes. Without further division these cells develop into the rudimentary spermatozoa. The females have the diploid number of fifty-two chromosomes, and when this number is retained in the mature egg it develops parthenogenetically into a daughter. When, however, the chromosomes are reduced to the haploid number of twenty-six in the mature egg, it either develops parthenogenetically into a male which produces functional spermatozoa containing twenty-six chromosomes, or it is fertilized and the diploid number of fifty-two chromosomes results and a female is produced.

EMBRYOLOGY

46. *Primordial sex-cells of the albino rat.* (Lantern; 15 min.) GEO. T. HARGITT,
Syracuse University and The Wistar Institute.

Twenty-seven embryos of known age were examined, covering the stages from the primitive streak to the sexual differentiation of the gonads. Cells which can be traced into the gonads and identified with the germ cells first appear coincidentally with the thickening of the coelomic epithelium to form the genital ridge. This takes place in an embryo of about 18 somites and the germ cells are modified peritoneal cells arising in situ. This differentiation of germ cells continues during the entire period under consideration and, in the female at least, for a much longer period. Large cells are found in earlier embryos in ectoderm, mesoderm, and entoderm, but these later disappear without evidence of migration into the genital region. Some of these large cells are clearly enlarged local cells whose division has probably been delayed; others forming in the peritoneum outside the genital region may be similar to germ cells, but they do not contribute to the formation of the gonad. A segregation of germ cells and their migration through a germ track into the gonad do not occur; germ cells differentiate from the surface of the developing gonad.

47. *Histogenesis of red sponge, Microciona prolifera Ver., from dissociated tissue cells.* (Lantern; 15 min.) PAUL S. GALTISOFF, U. S. Bureau of Fisheries.

The suspension of *Microciona* cells obtained by squeezing a piece of sponge through bolting-silk consists of the following types of cells: Archaeocytes, collencytes, desmacytes, pinacytes, and choanocytes. The amoeboid movement of the archaeocytes leads to the formation of globular cell aggregates strongly adhering to the substratum. The development of the aggregate begins by its spreading over the solid surface. Flagellate chambers, canals, and spicules are formed within five days. Spongin appears about the tenth day; the osculum develops by the end of the third week.

The regeneration is primarily the process of coming together of cells, accompanied by their further differentiation. The increase in number of cells takes place after the formation of sponge body. The archaeocytes play the most important, but not exclusive, rôle in regeneration, for addition of pinacocytes at least is necessary for the rebuilding of a new sponge.

A complete regeneration occurs in aggregates consisting of about 2000 cells or more. The aggregates composed of a small number of cells, from about 40 to 500, fail to develop into perfect sponges.

The rebuilding of a new sponge is due to the activities and properties of individual cells forming an aggregate. Within the common mass the different kinds of cells find each other and then develop into new organs. The dissociated cells do not become dedifferentiated. Each type retains its distinctive characteristic.

48. *The response of the developing limb of Amblystoma punctatum to variations in the orientation of the surrounding tissue.* (Lantern; 15 min.)

J. S. NICHOLAS, University of Pittsburgh School of Medicine.

Studies reported previously showed that a rotated limb bud tends to regulate its postural relationship to the embryo as a whole during its development. When the limb is placed in marked disharmony with its immediate surrounding, however, incomplete postural regulation, frequent reduplication, and symmetry reversals or inversion of the limb result.

When a 5-somite transplant is used, the embryonic limb develops with definite postural relation to the transplant, irrespective of its orientation to the embryo. When the 5-somite transplant is separated into a $3\frac{1}{2}$ -somite limb bud and a peribranchial area and each is rotated independently, the limb regulates its posture with direct relation to the peribranchial area, and not to the organism as a whole.

Left limb buds have been transplanted within the right peribranchial areas on both the right and left sides of the body and the two components rotated independently. The reciprocal operations have also been performed. These experiments show that the limbs regulate with respect to the peribranchial area, irrespective of its relationship to the organism as a whole.

The later larval stages show structural changes in the rotated girdle parts. This form regulation, while irregular, shows that the girdle parts tend to accommodate themselves to their changed organic relationships. Regulation, however, occurs too late to affect the posture of the limb which remains abnormal in posture.

49. *Partial pluteus larvae from isolated blastomeres of the two-cell stage of the egg of Arbacia.* (Lantern; 5 min.) HAROLD H. PLOUGH, Amherst College.

The blastomeres of the two-cell stage of *Arbacia* were separated with fine glass needles after the fertilization membranes had been removed by shaking. The subsequent development was followed in an attempt to demonstrate the facts long ago demonstrated by Driesch on other sea-urchin eggs. While normal gastrulae and plutei of one-half size resulted in about two-thirds of the tests, at least one-third of the isolated blastomeres which completed their development

were incomplete or partial plutei. Many of the latter showed one arm with a complete and normal half skeleton, and were of approximately the same length as the plutei from normal undivided eggs. The gut seemed to be complete, but small. The results have been secured in tests during three successive seasons at Woods Hole. Summaries of several series of experiments are as follows:

<i>Number of half blastomeres isolated</i>	<i>Died</i>	<i>Number gastrulae found</i>	<i>Normal half plutei</i>	<i>Defective or partial plutei</i>
185	46 per cent	54 per cent	15 per cent	8.6 per cent

Apparently even the undivided egg of *Arbacia* shows evidence of some sort of arrangement of materials, and the first cleavage may cut these in such a way that development is partial rather than complete.

50. *Ectodermal areas of the head in young human embryos.* (By title.)

G. W. BARTELMER, Department of Anatomy, The University of Chicago, and Department of Embryology, Carnegie Institution of Washington.

Certain areas of the head ectoderm can be distinguished by the height of the cells and their cytoplasmic differentiations. Plotting the areas on models of the external form made it possible to follow their history through a series of sixteen embryos belonging to the early period of somite formation. In a 2-somite embryo there are three distinct areas: 1) area V, corresponding to the future mandibular, maxillary, and ophthalmic regions innervated by the trigeminal nerve; 2) area hyoidea; 3) otic plate. In an 8-somite stage there are in addition a first gill membrane area and an area branchialis III which reaches caudally to the level of the first somite. During the 9- to 11-somite period, mandibular and hyoid arches, maxillary process and first gill membrane appear as eminences on the surface and the VII epibranchial placode is arising dorsally in the hyoid area. The placode soon comes into intimate relation with the acousticofacial neural crest, and both it and the adjoining hyoid area appear to contribute to the geniculate ganglion. In a 13-somite embryo the area V is highly differentiated and the second gill membrane has appeared. In the 16-somite stage there are clear evidences of cell migration from the area V as well as the more caudal visceral-arch areas. The differentiated head ectoderm now extends as far caudally as the third somite.

51. *Variation in the temperature coefficient of embryonic development of the grape leaf-hoppers.* (Lantern; 15 min.) CHESTER I. BLISS. (Introduced by R. H. Bowen.)

It is generally recognized that, within a limited temperature range and under constant temperature conditions, rate of embryonic development in insects is a function of temperature, from which Arrhenius' constant μ has been calculated, supposedly covering the entire process. Two lines of evidence are here advanced to demonstrate that a given temperature characteristic applies not throughout the entire stage under consideration, but only to part of it. 1) Leaf-hopper eggs laid on successive days during August, 1923, show a variation in the length of the embryonic period dependent upon the incidence of a five-day cold wave. Eggs exposed to the lower temperature during the middle part of development were

more retarded than those undergoing the cold period nearer the beginning or end of development. 2) By correlating the average (outdoor) temperatures for the different fifths of the embryonic period with the total length of development of each of 12,000 eggs (*Erythroneura tricineta*), the relative effectiveness of temperature during the successive fifths as determined by partial correlation methods corroborates the more direct data. These results indicate that several reactions differing in temperature coefficient limit the rate of embryonic development at successive stages, and that the whole embryonic period must include more than one growth cycle in Robertson's sense. Fluctuating temperatures must be weighted in reference to the relative temperature coefficients, and not simply averaged if the relation between a given temperature and length of development is to be determined.

52. *Experimental study of the development of the heart of Amblystoma.* (Lantern; 15 min.) W. M. COPENHAVER, Yale University. (Introduced by R. G. Harrison.)

Most of the operations were made at a stage when the pericardial space between somatic and splanchnic mesoderm first appears. The results are as follows: 1) After removal of the heart anlage, tissue which normally does not form the heart may form a normal organ; also described by Ekman ('21). 2) By extirpations of relatively large areas of mesoderm, animals without hearts may be produced. 3) Transplantations with normal orientation give normal hearts. 4) Transplantations with 180° rotation about the dorsoventral axis give hearts which pulsate in anteroposterior direction. Sinus is anterior; conus posterior. There is no circulation. 5) Anlage may be transplanted to other parts of body and develop hearts, as described by Stöhr ('24). In *Amblystoma* these pulsate in direction corresponding to original axis of transplant. 6) Two hearts from one anlage result after removal of a median piece and transplantation in its place of a piece of ectoderm and mesoderm from a more posterior region as a block. 7) Normal hearts with normal circulation were obtained from right, left, anterior, or posterior halves; and from two right, two left, two anterior, or two posterior halves. 8) Transplantation of one anlage upon another gives a normal heart with circulation when transplant is normally orientated. 9) Normal hearts with normal circulation develop after removal of halves as late as just before beginning pulsations.

The results indicate that for the stages studied the heart of *Amblystoma* is an harmonic equipotential system with the elements irreversibly differentiated along an anteroposterior axis.

COMPARATIVE ANATOMY

53. *The integumentary, pulmonary, and cardiac modifications correlated with increased cutaneous respiration in the amphibia.* (Lantern; 15 min.) G. K. NOBLE, The American Museum of Natural History.

Astylosternus robustus has greatly reduced lungs. All Amphibia exhibiting such a reduction have their epidermis either penetrated by capillaries or thinned to facilitate greater cutaneous respiration. The epidermis of both sexes

of *A. robustus* is penetrated by capillaries. The 'hairs' of the adult male are merely extensions of this vasculated epidermis to compensate for the greater muscularity, size, and activity of this sex. They are permanent structures.

The digits of terrestrial urodeles do not serve as special centers of cutaneous respiration. Digital sinuses are present in all urodeles. The abdominal and femoral tubercles of arboreal and some terrestrial frogs may function greatly in respiration, for their epidermis is penetrated by capillaries.

All urodeles and frogs having well developed and frequently emptied lungs possess a functionally complete auricular septum and a spiral valve. Injection experiments demonstrate a complete separation of arterial and venous blood in living specimens. A reduction of the lungs conditions a reduction of the left auricle, but disuse causes no change in size. A great decrease of the lungs, or even a disuse of them, conditions a fenestration of the auricular septum and a loss of the spiral valve. There is no separation of the blood streams in forms with such modifications. The spiral valve is formed by a backward growth of one of the synangial valves and is not homologous with the accessory valves of dipnoans. Lungless salamanders have no left auricle and no spiral valve.

54. *Cephalic glands of snakes and alligators.* (Charts; 10 min.). ALBERT M. REESE, West Virginia University.

In the genus *Agkistrodon* the glands of the head are large and numerous. The position and structure of the following are described and figured: 1) harderian, 2) nasal, 3) poison, 4) superior labial, 5) inferior labial, 6) anterior or lateral sublingual, 7) posterior or median sublingual.

In the alligator (and caiman) the cephalic glands are numerous, but not so well developed and not so well known as in the snakes. The position and structure of the following are described and figured: 1) harderian (lacrimal), 2) gland of upper eyelid, 3) gland of lower eyelid, 4) gland of nictitating membrane, 5) nasal, 6) maxillary, 7) palatal, 8) lingual.

55. *Mechanisms in ciliated epithelia of the gill of the oyster by which ciliary movement may be coordinated.* Demonstration; 15 min.) CASWELL GRAVE AND F. O. SCHMITT; Washington University.

Permanent systems of fibers that have been demonstrated to be present in ciliated epithelia of the gill of the oyster will be described and discussed. Reasons will be given for interpreting these systems of fibers as conduction paths for coordinating and regulating impulses rather than as supporting structures. They are essentially similar to those found by Grave and Schmitt in ciliated epithelia of fresh-water mussels, one of which is described and figured in a preliminary paper published in a recent number of *Science* (vol. 60, no. 1550).

56. *Aberrant secondary sexual characters in crayfishes (Cambarus).* (Lantern; 15 min.) C. L. TURNER, Beloit College.

Crayfishes having aberrant combinations of secondary sexual characters and supernumerary secondary sexual characters are being found in large numbers in southern Wisconsin.

The following aberrant combinations are found: 1) Females with one male character. 2) Females with another male character. 3) Females with two male characters. 4) Females with three male characters. 5) Females with three male characters and a supernumerary female character. 6) Males with one female character.

The specimens bearing supernumerary characters may be classified as follows: 1) Males with one supernumerary character. 2) Males with another supernumerary character. 3) Males with two supernumerary characters. 4) Females with one supernumerary character. Some of the above combinations are rare, others are quite common.

The possibilities that the aberrant conditions can be accounted for by parasitism, by peculiarities of temperature or of food or that they are hermaphroditic have been eliminated. There is some good evidence that the peculiarities are being inherited.

57. *The reproductive system of Apotettix eurycephalus Hancock.* (Lantern; 15 min.) MARY T. HARMAN, Kansas State Agricultural College.

Under the female reproductive system are considered the ovaries, oviducts, vagina, spermatheca, and spermathecal gland. No colleterial glands are present. The ovaries are paired and each is composed of about eighteen ovarian tubules. Each tubule terminates in a cup-shaped modification of the oviduct, the egg calyx. The epithelial lining of the oviduct is glandular. The spermatheca is a bladder-shaped sac situated dorsal to the two ovaries and between them. It opens into the vagina near the exterior and is filled with spermatozoa after copulation. Spermatozoa have not been found in any other part of the female. Dorsal to the spermatheca and lying against it is the spermathecal gland. It is connected with the spermatheca by an elongate spermathecal duct.

Under the male reproductive system are considered the testes, vas deferens, accessory glands, and the penis. Each testis is composed of eight to ten cone-shaped follicles. Each follicle is made up of a number of cysts arranged so as to give it the appearance of being segmented. All of the cells of each cyst are in approximately the same stage of development. No seminal receptacle is present. Each follicle is connected with the vas deferens by an efferent tube. The paired vas deferens opens into the sac-like intromittant organ or penis. The terminal portion of the penis may be everted, and when everted is conical in shape. At its base is a thin chitinous collar, the margins of which are thickened, forming ridges.

58. *Abnormalities in number and location of the gonads of certain Lumbricidae.* (Lantern; 10 min.) FRANK SMITH, University of Illinois.

Nine abnormal specimens of *Helodrilus subrubicundus* (Eisen) have been examined and found to exhibit several of the different types of abnormalities in gonad relations known in other species of Lumbricidae. There is some evidence that regeneration of the anterior part of the worms may account for some abnormalities, and irregularities of metamerism doubtless account for others, but many are due to causes not yet understood.

In normal specimens of the various species of Lumbricidae the two pairs of spermaries (testes) are in the tenth and eleventh somites and paired ovaries are in the thirteenth, while the twelfth somite is without gonads. The esophageal pouches of the calciferous gland, when present, are in the tenth somite; the posterior pair of 'hearts' is in the eleventh, and the posterior ends of the two laterolongitudinal vessels join the dorsal vessel in the twelfth somite. In abnormal specimens in which the location of any of the gonads differs from that which is normal, there are commonly corresponding differences in the location of the other organs mentioned. In many specimens abnormality may be evident on but one side. Supernumerary gonads are of frequent occurrence, and when present are often represented in the twelfth somite or in the one corresponding to it. They may be present on both sides or on but one side, while the gonads of the other side have normal relations.

59. *A case of unilateral or true gynandromorphism in a leopard frog.* (Lantern; 10 min.) H. V. NEAL, Tufts College.

Hermaphroditism is general, if not universal, in immature frogs. Unisexuality develops in later stages as a result of the degeneration of one or the other of the two kinds of germ cells. Rarely the primary hermaphroditism persists more or less completely in mature individuals. The specimen described in this paper is a leopard frog of over 3 inches' body length, and, according to the dealer, over three years old. The thumb-pads, characteristic of a male frog, are present and well developed. The germ gland of the left side is, correspondingly, a testis $6\frac{1}{2}$ mm. in length with crypts filled with mature spermatozoa. A large Bidder's organ, somewhat anomalous in this species of frog, is associated with the testis and the fat-body of this side. The relations of the vasa efferentia to the 'kidney' and of the muellerian duct to the wolffian duct are those characteristic of a male frog. On the right side, however, the gonad is a lobulated ovary 9 to 10 mm. in length, filled with unpigmented eggs. No Bidder's organ is found on this side. Sections show typical ovarian structure without crypts or spermatozoa and without any evidence of degeneration of ova. The relations of blood vessels are those characteristic of the frog ovary. The bearing of these facts upon current theories of sex differentiation is briefly presented.

60. *The rabbit egg as a taxonomic character.* (By title.) CARL G. HARTMAN, The University of Texas.

Gidley (Science, 1912) gives reasons for elevating the Lagomorpha (rabbits and hares) to an independent order on the par with the Rodentia. The egg is clearly a structure that should be added to the list of distinctive characters: 1) Of all Eutheria the rabbit is the only one in which the egg gathers accretions of albumen about the zona pellucida during the tubal journey. This fact also implies a profound difference in the function, if not the structure, of the oviduct. It is worthy of note that these characters the Lagomorpha share with the Marsupials, all of which possess the albumen envelope together with a shell membrane, absent in the rabbit egg. 2) In the rabbit the primitive streak is superficial; in most rodents there is the so-called inversion of germ layers correlated with the very early embedding of the ovum in a decidual crypt entirely shut off from

the uterine cavity. After Rauber's layer has disappeared from the region of the germinal disc in the rabbit egg, the disc and its developing embryo become superficial and the bilaminar and early trilaminar blastocyst become the exact counterpart of the marsupial ovum at the corresponding stage, except that in the latter there still exists the shell membrane.

61. *The gonads of a sex-intergrade opossum.* CARL HARTMAN and BESSIE LEAGUE, University of Texas.

This specimen was briefly described by one of us (Science, 1920) as a 'reciprocal free-martin.' Externally the animal possessed male habitus, an empty scrotum and a penis as in a large normal male. There is present Gartner's duct, and the mullerian-duct derivatives are exactly as in the immature female. The gonads have the situation of ovaries. The characters are, therefore, exactly the reciprocal of the free-martin of cattle. Recent study of the opossum ovary has furnished the key to the interpretation of the gonads: 1) Rete ovarii as in the normal ovary. 2) In the center there are not testicular tubules, but anovular graafian follicles, probably from the first proliferation of the germinal epithelium, which occasionally develops follicles (Allen). 3) In the cortex, cords of cells, probably from the second proliferation, which in this case yielded medullary cords instead of Pflüger's egg tubes. The specimen may therefore be a case of partial sex reversal. Since at birth the opossum embryo shows no visible trace of sex differentiation (according to Dr. C. H. Heuser, this begins twenty-four hours later), our specimen can hardly be a reciprocal free-martin; that is, a male changed toward the female side by blood community with a female fetus in utero.

EVOLUTION

62. *Factors in the evolution and phylogeny of the Proboscidea.* (15 min.)
HENRY FAIRFIELD OSBORN, American Museum of Natural History.

The writer has been engaged since 1907 in intensive study of the evolution and phylogeny of the Proboscidea in comparison with similar studies on the early evolution of the primates, on periods in the evolution of the rhinoceros family, and on the complete evolution from beginning to end of the families of titanotheres and horses. The factors concerned in these five structurally diverse groups appear to be the same, namely, the concurrent action, reaction, and interaction of four sets of forces which condition each organ: 1) environment; 2) initiative and habit of the organism; 3) self-adaptation to the living environment; 4) progressive heredity. The adaptive habit, or lamareckian factor, never results in immediate inheritance, but always in ultimate inheritance, through organic selection by a process of delayed inheritance. These four energetic factors continuously combine in the process known as tetraplasy, and the resultant is continuously submitted to natural selection. Every organ is tetraplastic in the sense of being invariably molded by four sets of mechanical influences.

Evolution may be regarded as primarily physical, then physicochemical, then physico-chemico-mechanical. Observations of palaeontologists are confined to mechanical evolution. Progressive heredity in all mechanical structures is invariably orthogenetic. In all the five groups of animals observed during the past

twenty-five years no evidence whatever of evolution through chance or fortuitous variation has been found; on the contrary, there is overwhelming evidence for continuous rectigradation in lines of increasing perfection of mechanical adaptation.

63. *Certain features of the termite-caste problem.* (10 min.) HAROLD HEATH, Stanford University.

According to one view, newly hatched termites are all alike and subsequently are changed into various types of adults through the influence of external agencies. The counter theory assumes that the soldier and reproductive castes, at least, are recognizable at the time of hatching. In two California species of the genus *Termopsis* there are no indications of more than three castes: the winged insects, soldiers, and, in older colonies, substitute royal forms which have never been found to include the so-called second form. Several hundred individuals, of various instars, have been carefully preserved, stained, and measurements have been made of the head width, size of the brain and eyes and to some extent the bulk of the gonad. The plotted results show no differences, beyond those of ordinary variation, through the third instar. In the fifth instar the width of the soldier head is greater than that of the nymph, yet the size of the brain continues to be the same in each. Furthermore, at least three years elapse after the founding of the colony before winged individuals appear, and then only in small numbers. Further investigations, including experiments with living material, are being conducted and may modify results, but at the present time no support has been found for the germ-plasm theory to account for the origin of castes in *Termopsis* and apparently in *Kaloterme minor*.

PROTOZOÖLOGY

64. *The opalinid parasites of adult and larval Anura.* (Opaque projection or charts; 10 min.) MAYNARD M. METCALF.

Adult *Anura* of some species are uninfected, while the larvae are infected. In many species the adults are less usually infected than are the tadpoles. The adults are not infected when there are no infected tadpoles, for infection is acquired in the tadpole stage. Species without free-living tadpoles, e.g., *Pipa*, *Liopelma*, are not infected. If tadpoles are present in the pools throughout the whole year rather than merely during the summer in cold countries or during the rainy season in the tropics, adults of the same species are likely to be uninfected or only rarely infected, the infection passing from tadpole to tadpole without the parasites passing to the adult through the difficult period of metamorphosis of the host.

Some species of *Opalina*, a highly evolved genus, have in the tadpole hosts a definite larval stage, or in one instance three such consecutive larval stages each resembling one of the less evolved genera. These *Opalinae* thus in their ontogenetic development repeat by definite larval stages the phylogeny of their genus. Professor Wenrich was the first to find the forms which give the best example of this recapitulation.

65. *A new parasitic Ameba from salmonoid fishes.* (Lantern; 10 min.) H. S. DAVIS, U. S. Bureau of Fisheries.

An interesting species of ameba has been found in trout from several localities east of the Mississippi River and in salmon from the Pacific coast. The vegetative stages occur in the stomach where they can often be found in large numbers in the mucus covering the epithelial lining. The majority of the vegetative stages are mononuclear, but multinuclear forms also occur in considerable numbers. Cysts develop from both the mono- and multinuclear stages. These cysts are multinucleate, containing from four to a large number of nuclei when first formed. After encystment the nuclei divide by a very simple form of mitosis and the organisms may show a considerable increase in size. Later the cysts divide into a number of distinct cells which eventually become separated from each other. At this time the cysts strikingly resemble segmenting eggs except that each cell contains several nuclei.

66. *Intestinal flagellates in tropical America.* (10 min.) R. W. HEGNER, Johns Hopkins University.

Stools were examined during the summer of 1924 of native inhabitants in Tela, Honduras, Port Limon, Costa Rica, and Santa Marta, Columbia. One examination was made of each of 286 patients. The results show an incidence of infection with *Giardia lamblia* of 2.1 per cent, with *Chilomastix mesnili* of 7.7 per cent, and with *Trichomonas hominis* of 20.6 per cent. The population examined is about six times more highly infected with *Trichomonas hominis* than previous reports indicate is true of inhabitants in temperate Europe and America, about twice as highly infected with *Chilomastix mesnili*, but only about one-fifth as highly infected with *Giardia lamblia*. The greater incidence of *Trichomonas* and *Chilomastix* can be explained by, 1) the better chances of transmission in the warm and unsanitary tropics and, 2) by the diet of the natives, which consists almost entirely of vegetable foods. Observations and experiments on mammals and man seem to indicate that a vegetable diet is favorable and a carnivorous diet unfavorable for the growth and multiplication of these flagellates. No explanation is offered for the low incidence of *Giardia lamblia*.

67. *Life-history of Haplozoon.* (10 min.) WALDO SHUMWAY, University of Illinois.

A reinvestigation of the characters of *Haplozoon* (*Microtaeniella*) *clymenellae* indicates that this species is one of the parasitic dinoflagellates. In the host, *Clymenella torquata*, the parasite is first found as a single cell attached to the epithelium of the intestine. From the distal end of this trophocyte, smaller cells, the gonocytes, are formed, and these divide in turn until a large colony of two or three hundred cells is built up. The cells at the distal end of the colony undergo a transformation in which a quadrinuclear condition is reached and then become detached from the colony as sporocytes. These encyst and are egested. In the sea-water from these cysts emerge tiny gymnodinium-like forms, the dinospores, which may reencyst and divide, giving rise to four daughter cells. No conjugation between these dinospores has yet been observed. It is suggested that the dinospore represents a free-living sexual generation reminiscent of the ancestral form rather than a gamete.

68. *The effects of starvation and oxygenation on the symbiosis between termites and their intestinal protozoa, together with the toxicity of oxygen for free-living and parasitic protozoa.* (Charts; 15 min.) L. R. CLEVELAND, National Research Council Fellow, Johns Hopkins University.

Four termite genera have been studied. In *Termopsis*, which is always teeming with *Trichonympha*, *Leidyopsis*, *Trichomonas*, *Streblomastix*, a combination of starvation and oxygenation gives the following protozoal groupings: 1) 6 days' starvation, *Leidyopsis*, *Trichomonas*, *Streblomastix*; 2) 8 days' starvation, *Trichomonas*, *Streblomastix*; 3) 24 hours' oxygenation at one atmosphere, *Trichonympha*, *Leidyopsis*, *Streblomastix*; 4) 24 hours' oxygenation at one atmosphere and 6 days' starvation, *Leidyopsis*, *Streblomastix*; 5) 24 hours' oxygenation at one atmosphere and 8 days' starvation, *Streblomastix*; 6) 7 hours' oxygenation at 1.5 atmospheres, *Trichonympha*, *Leidyopsis*; 7) 7 hours' oxygenation at 1.5 atmospheres and 6 days' starvation, *Leidyopsis*. Oxygenation for 72 hours at one atmosphere, 9 hours at 1.5, 5 hours at 2, 2 hours at 2.5, 1 hour at 3, 30 minutes at 3.5, removes all protozoa. Methods which remove protozoa leave hosts uninjured. Forty hours' oxygenation at 3.5 atmospheres kills about half of hosts, while forty minutes kills all protozoa. After removal of protozoa, termites eat wood normally. This makes it possible to work out accurately the relation of each genus to its host and to its fellow-protozoa. Hosts with either *Trichonympha* or *Leidyopsis* live indefinitely, with *Trichomonas* about seventy days. *Streblomastix* is of no value. It, like termites, depends on other protozoa. The protozoa of frogs, cockroaches (probably any insect), free-living protozoa, and parasitic protozoa in culture are all killed by oxygenation.

69. *The structure and division of Paramecium trichium Stokes.* (Lantern; 15 min.) D. H. WENRICH, University of Pennsylvania.

Paramecium trichium, the smallest of the seven species recognized by Woodruff in 1922, varies from 50 to 110 μ long with most individuals between 80 and 90 μ . The width varies from one-third to one-half the length. It is somewhat depressed dorsoventrally. The broad buccal groove extends from the anterior left border diagonally across the ventral surface to the mouth, which is usually slightly anterior to the middle and close to the right side. The mouth leads into a relatively long cytopharynx which contains an undulating membrane. The cytopyge is subterminal and the small caudal tuft of longer cilia is subapical. The plastic ectosarc contains numerous trichocysts. A contractile vacuole apparatus occurs near either end. Each is deeply located and stains more intensely than surrounding protoplasm in prepared slides. In life there appear to be two alternately contracting vacuoles with smaller ones adjacent. Contractions are from fifteen to twenty-five per minute. The macronucleus is medium in size and the single micronucleus is of the caudatum type.

Binary fission appears to be initiated by a metaphase-like condition of the micronucleus. This is followed by great enlargement and the eventual separation of the chromatin threads into two anaphase groups. The metaphase thus appears to precede the changes which correspond to a prophase in other cases. During division of the body the two old contractile vacuoles persist as the posterior ones for the daughters, new anterior ones being developed.

70. *Trichomonad flagellates in the coecum of rats and mice.* (Lantern; 15 min.)

D. H. WENRICH, University of Pennsylvania.

Examination of 343 rats and 122 mice for intestinal protozoa has yielded three species of *Trichomonas* (*Tritrichomonas*), one of *Pentatrichomonas* and one of *Pentatrichomastix*, in addition to other protozoa. Brief descriptions of these trichomonads follow. Measurements are from fixed and stained material.

Trichomonas muris Galli-Valerio, the most common species; 8 to 20 μ long; three anterior flagella relatively short; undulating membrane and chromatic basal rod well developed; axostyle broad and hyaline, projecting slightly posteriorly; parabasal body (Janicki) present; six chromosomes in division. In rats and mice.

Trichomonas minuta, n.sp.; similar to *T. muris* in organization but smaller, 3 to 10 μ long; three chromosomes in division. In rats and mice.

Trichomonas parva Alexeieff (tentative identification); 5 to 10 μ long; undulating membrane short; three anterior flagella as long as body, somewhat unequal among themselves; axostyle slender, projecting one-fourth to one-third the body length posteriorly; anterior third of body contains deeply staining material as granules or a chromatic cloud. In rats.

Pentatrichomonas sp.; 7 to 12 μ long; five anterior flagella, four attached to a larger blepharoplast, and one to a separate, smaller, blepharoplast; undulating membrane and chromatic basal rod less developed than in *T. muris*; axostyle more slender than in *T. muris*, projecting one-fourth to one-third the body length posteriorly. May be identical with *Pentatrichomonas* of man. In rats.

Pentatrichomastix muris, n.g., n.sp.; 5 to 12 μ long; five anterior flagella and one trailing flagellum; axostyle slender, usually staining deeply, projecting posteriorly up to one-third the body length. In rats.

71. *Conjugation in Dileptus gigas.* (Lantern; 10 min.) J. PAUL VISSCHER, Western Reserve University. (Introduced by S. O. Mast.)

In conjugation fusion occurs along the entire oral surfaces of the proboscides of *Dileptus gigas*. Two size-reducing divisions occur in rapid succession, immediately preceding conjugation. Only one of the many micronuclei takes part in the process of nuclear reorganization. The pronuclei are derived from this micronucleus and interchange occurs immediately preceding separation of the mating individuals. The fertilization nucleus divides to form two nuclei of diverse size. The smaller one produces 32 or 64 micronuclei, while the larger one divides to produce a like number of macronuclei, each of which breaks up into many granules which form the numerous densely staining nuclear derivatives which are characteristic of the vegetative stage of *Dileptus gigas*.

72. *A neuromotor apparatus in Dileptus gigas.* (10 min.) J. PAUL VISSCHER, Western Reserve University. (Introduced by S. O. Mast.)

A system of fibers has been found in *Dileptus gigas* which is probably a neuromotor apparatus. A distinct elongated basal rod, found near the base of the gullet, gives rise to three sets of fibers: 1) a set of heavy fibers radiate out around the funnel-shaped gullet; 2) a pair of heavy fibers pass directly from the basal rod to the band of trichocysts, one on each side, extending to the tip of the proboscis; 3) a set of very delicate branching fibers are distributed over the surface of the organism.

This system of fibers is held to be a neuromotor apparatus, because, 1) the general structure and appearance of the fibers suggests a neuromotor function and, 2) there is little or no evidence indicating any other function, and because, 3) the fibers in this system are connected to the most highly specialized structures in *Dileptus*, and, finally, because, 4) they are similar to structures found in other forms, for which a neuromotor function has been experimentally demonstrated.

PARASITOLOGY

73. *Infection with Diphylobothrium*. (Lantern; 15 min.) THOMAS BYRD MAGATH, Mayo Clinic.

Seven individuals infected with *Diphylobothrium* have been carefully studied with regard to their clinical symptoms and findings, their geographical distribution, and the morphology of the worms removed by treatment.

One specimen, including the head, corresponding to *D. parvum* has been obtained, and it has been compared with typical specimens of *D. latum* with a view of deciding its systematic position.

74. *The opalinid parasites and the geographical distribution of the bell-toads (Discoglossidae); with a criticism of the age and area hypothesis*. (Opaque projection or charts; 15 min.) MAYNARD M. METCALF.

Bell-toads are found in Europe and northern Africa (2 genera, four species), in eastern and southeastern Asia (one genus, 2 species), in the Olympic and Siskiyou Mountains of westernmost North America, and in the mountain fastnesses of Otago Island in New Zealand. The characteristic opalinids of the Euro-Asian bell-toads are found also in the sole American species. The New Zealand genus lays eggs which hatch directly to young toads under damp stones, and so it has no opportunity to become infected. However, two Australian hylas carry opalinid parasites of the sort characteristic of the bell-toads. This is an indication of former presence in Australia of bell-toads now extinct. That they existed in Australia from Jurassic times, when they immigrated from Asia, through the Cretaceous into the Tertiary is indicated by the presence of their parasites in Australian hylas which first reached Australia from tropical America in the Tertiary.

The hypothesis that age of group and distribution area are correlated must be used only with great caution. *Ascaphus* reached its present home in the Olympic and Siskiyou Mountains during the Cretaceous and has never spread eastward. *Bufo*, *Hyla*, *Rana*, and the leptodactylids, in contrast, though more modern forms, have spread widely and this chiefly in the Tertiary. Width of distribution is correlated with vigor rather than age.

75. *Notes on the relationships of the Acanthocephala*. (Charts; Lantern; 15 min.) H. J. VAN CLEAVE, University of Illinois.

The Acanthocephala have usually been classed as a group of the round-worms. Various writers have demonstrated the fact that the two groups have little in common. In this paper will be assembled the chief lines of evidence from morphological and embryological studies supporting the view of a possible origin from and relationships with the group of the flat-worms.

The eggs and embryos of *Acanthocephala* in their development closely resemble conditions found in cestode eggs and embryos. Three shells surround a single-layered ectoblast which encloses a solid entoblast.

Highly characteristic organs, such as the lemnisci of the *Acanthocephala*, are coenogenetic.

The proboscis and its associated structures are morphologically similar to the cirrus and cirrus-sac of some cestodes. Detailed evidences of this comparison will be presented.

76. *Effect of parasitism on fowl thymi.* (Lantern; 10 min.) JAMES E. ACKERT, Kansas State Agricultural College.

Further studies on the effects of the parasite *Ascaridia perspicillum* on chickens indicate that the thymi of parasitized chickens are smaller than those of non-parasitized chickens. In the experiments from which this inference was drawn White Leghorn chicks of the same brood, on hatching, were placed in a screened animal house where, with ample light, heat, and space, they were given an adequate ration. After developing normally for about one month, the chickens were divided into two lots and kept under the same conditions, except that one lot was parasitized by the administration of infective eggs of the nematode *Ascaridia perspicillum*.

In from two to seven weeks after the chickens were parasitized the respective lots of chickens under comparison were killed and the long thymi of each chicken removed at once and weighed. The average weight of the thymi of the twenty-three control chickens was 1450 mgs., while the weight of the thymi of the thirty-one parasitized chickens averaged only 604 mgs., showing that the thymi of the parasitized chickens were decidedly smaller than those of their controls and indicating that the thymi of the chickens parasitized with *Ascaridia perspicillum* were affected.

77. *The effect of the nematode Ascaridia perspicillum on the blood-sugar content of chickens.* (Lantern; 10 min.) JAMES E. ACKERT and R. W. TITUS, Kansas State Agricultural College.

While studying the effects of parasitism on chickens, it was found that the blood-sugar content of the fowls parasitized with *Ascaridia perspicillum* was lower than that of non-parasitized chickens.

In a series of experiments, baby chicks from the same brood were taken from the incubator, placed in an experimental animal house, and given an adequate ration. When about one month old, the chickens were divided into two lots and kept under the same conditions, except that one lot was parasitized by being fed infective eggs of *Ascaridia perspicillum*, the other lot serving as controls. About two weeks later all parasitized and control chickens were starved for several hours and blood samples taken from the heart. The blood samples were then tested for sugar content by the Folin-Wu method.

The results of such tests run on twenty-five control chickens and on twenty-eight parasitized ones showed that the blood-sugar content of the parasitized chickens was distinctly less than that of the controls, the difference between the two means being more than six times its probable error, which shows that the chances are over 20,000 to 1 that the difference is significant.

78. *An occupational disease of zoölogists.* (15 min.) B. H. RANSOM and J. F. COUCH, U. S. Bureau of Animal Industry, Washington, D. C.

Among parasitologists, cytologists, and others who come in contact with worms of the genus *Ascaris* and related genera there the individuals who suffer in varying degrees of severity from the toxic effects of these parasites with symptoms similar to those in cases of so-called sensitization to foreign proteins. A study of the question of the nature of the offending substance or substances in *Ascaris lumbricoides* has shown that the tissues of the parasite contain material either of a protein nature or closely associated with proteins, and thus far not fully separable from them, which is toxic to susceptible persons.

It is soluble in water, insoluble in alcohol and acetone, present in the fraction of an aqueous extract of the worms obtained by precipitation with saturated ammonium sulphate solution, absent in the globulin fraction obtained by precipitation with half-saturated ammonium sulphate solution, present in the filtrate from the aqueous extract after the precipitation of the globulin and albumin fractions, non-volatile, thermolabile (destroyed by 100°C. acting for about an hour), oxidizable by potassium permanganate, destroyed by pepsin digestion, but resistant to trypsin digestion, dialyzable through a parchment membrane, readily filterable through a collodion membrane that holds back hemoglobin, precipitated from acidified solutions by Mayer's reagent, adsorbed from acidified solutions by Lloyd's reagent, and active in high dilutions (one part of the albumin fraction to 100,000 parts of water giving a positive reaction when a drop is applied to a scratch in the skin of a susceptible person).

79. *Experiments on the production of soil infestation with hookworm larvae by the use of human excrement as fertilizer.* (15 min.) W. W. CORT, Johns Hopkins University.

Experiments were carried on in Soochow, China, in the summer of 1924 to determine some of the conditions influencing the development of infective hookworm larvae in the soil from viable eggs contained in human feces used as fertilizer. The attempt was made to follow the methods employed by the farmers in the use of the fertilizer, which was all used much diluted with water according to the wet method.

It was found that the pouring of the fertilizer containing viable hookworm eggs into swallow pits at the base of mulberry trees produced large numbers of infective larvae. When the fertilizer was used in boxes in which rice plants were being grown under water, almost no larvae developed and the hookworm eggs present in the fertilizer died in from two to three weeks. When fertilizer containing viable hookworm eggs was used on beds of Chinese turnips, which were watered morning and night, only a very small percentage of the eggs produced infective larvae. This number was very much increased when the soil between the rows was turned up with a hoe before the application of the fertilizer. The high death rate in the vegetable plots was apparently due to the action of the sun's rays in drying the surface of the soil.

80. *Infectious anemia of horses—a comparison of field and experimental cases.*
(Lantern; 12 min.) JOHN W. SCOTT, The University of Wyoming.

Some workers on infectious anemia of horses have stated that the disease produced experimentally by inoculation of blood or by other means is milder in character than the disease produced in nature under field conditions; that the percentage of fatalities in field cases is higher; that experimental cases frequently do not develop characteristic symptoms of the disease; the inference being that any sort of blood inoculation, as by biting flies, does not represent natural transmission of the disease. Observations on eighty experimental cases and on a considerable number of field cases both in the field and maintained under experimental conditions have led to the following explanation: 1) Many mild cases that ordinarily escape observation in the field are detected under experimental conditions. 2) Effects of the disease are ameliorated by good feed, by protection from exposure, by rest from work. 3) Experimental inoculation of blood probably induces the disease in some animals that would be immune in nature. 4) Clinical observations, course of the disease, temperature records, and blood studies indicate identity of the disease under the two conditions. It is concluded the differences are apparent rather than real, and do not constitute a serious objection to the insect theory as a natural means of transmission.

81. *A complete specimen of Dip. grandis.* (By title.) SADAŌ YOSHIDA and RYOZO TAKANO, Medical College, Osaka, Japan.

In the beginning of March, 1923, the junior writer received a piece of the bothriocephalid tapeworm of about 3 meters from one of his patients which was instantly identified by the senior to be *Dip. grandis*, a very rare human cestode. On March 12th, a complete worm of 7 meters was caught with the aid of vermifuge.

Only four cases of this species were recorded hitherto in any case of which the scolex was not seen.

Our specimen is perfect and provided with scolex and measures 10 meters in total length. The breadth and length of the segments gradually and regularly increase from the anterior to the posterior end, the maximum breadth and length being 25 mm. and 2.5 mm., respectively.

The scolex is quite different in form from that of any known species of this genus or of any dibothriocephalid species. In the side view, it extends sharply toward the anterolateral end, making the funnel-shaped appearance. It is 1 mm. in maximum breadth and 1.1 mm. in length. The sucking grooves are situated in the dorsal and ventral flate as usual, but they are the most characteristic in form, not merely the longitudinal groove, but also the canal formed by overlapped edges, its anterolateral end being open. Other external as well as internal characters almost agree with those of the first and second cases described by Ijima and Kurimoto and by Kurimoto, respectively.

Nothing is known about the life-history of this cestode. In each previous case the patient was living by the sea and had an individual habit to take the raw meat of fishes as food. On the other hand, some species of this genus are parasitic in the sea mammals, as seals and whale. From these facts, it is probably supposed that the larva of this cestode may be found in some

animals living in the sea-water. The present case, however, is a little different in this respect, the patient aged fifty-eight years lived in his native district, the mountainous region, far from sea, and never moved away from his home, except his coming to Osaka to live with his son on account of his illness about one year ago. In his native habitat, he did not have access to fresh meat of sea animals.

82. *Main source of Ascaris infection in Japan.* (By title.) SADA O YOSHIDA, Medical College, Osaka, Japan.

Among others of the developmental studies on *Ascaris*, the writer engaged to find the main source of *Ascaris* infection, which, it is estimated, infected on an average 70 per cent to 80 per cent of the inhabitants. In some districts all people are suffering from infestation with this parasite. Thus the ascariasis may be called the national disease in this country. From any point of view, therefore, it is most important to know what is the main source of this infection.

In Japan the *ascaris* eggs excreted with feces are naturally distributed over a wide extent by using human excreta as fertilizer in the fields, such as the rice-field, the wheat-field, and the kitchen garden. In these fields or gardens a majority of the eggs is found in the upper surface layer of this soil and much less in the lower layer. From this observation, the writer found very often the eggs on the lower leaves of the vegetables spoiled with the soil particles. Such eggs are stuck so firmly on the leaves that a usual washing cannot perfectly remove the eggs from the vegetables, as radish (*Daikon*) and turnip (*Kabura*). The writer often observed some eggs adhering to the cleaned vegetables, and even in the fluid of the salted vegetables of which we Japanese are very fond. This observation may serve to explain why a higher percentage of *Ascaris* infection is found among the people habitually taking the raw or the salted greens as food. The habit prevails among all classes of people in Japan, especially in country districts where the highest percentage of this infection is observed.

83. *A survey of the marine gastropods from the vicinity of San Juan Island, Puget Sound, with respect to larval trematode infestation.* (Lantern; 10 min.) HARRY M. MILLER, JR., Washington University. (Introduced by Caswell Grave.)

Fifteen species of eleven genera of marine gastropods, mostly snails, were examined for larval trematode infestation. The 1193 individuals were collected in or close to the intertidal zone or dredged from depths down to 30 meters. Only six species of snails were found to be infested: *Bittium eschrichtii*, *Littorina scutula*, *Purpura foliata*, *Searlesia dira*, *Thais lamellosa*, and *Thais lima*; all of these snails were found only between tide levels, and showed infestation up to 35 per cent. Of the remaining nine species some were both intertidal and dredged forms; none of these were infested. Six species of cercariae were found; two stylet, one cystophorous, one stumpy-tail, one binoculate distome, and one distome with a huge tail. Hitherto but three species of marine cercariae have been described from North America; these were from the Atlantic coast. This is the first report of marine larval trematodes of the Pacific coast.

84. *A new nematode of the rabbit.* (By title.) BERTHA L. DANHEIM, Kansas State Agricultural College. (Introduced by James E. Aekert.)

While making parasitological examinations of seventy common wild rabbits (*Lepus floridans mearnsi* Allen), in the vicinity of Manhattan, Kansas, nearly 1000 small nematodes were found in each of three of the rabbits. Studies on both live and preserved specimens have led to the conclusion that the nematodes are *Oxyuris evoluta* Linst. reported from porcupines.

Comparisons of our measurements with the descriptions of von Linstow and Hall show agreement in the essential points. The size range, however, of those from the rabbit is somewhat lower than that of the porcupine specimens. This appears to be a new record of *Oxyuris evoluta* Linst. from the common wild rabbit.

85. *Observations on the occurrence of Rhabditis hominis in the United States.* (15 min.) J. H. SANDGROUND, Johns Hopkins University. (Introduced by W. W. Cort.)

Rhabditis hominis Kobayashi, a nematode previously recorded from human feces in Japan and considered to be able to maintain itself in the intestine of man, is now recorded for the first time from America. The worms were found in large numbers in nine fecal samples from children in Virginia and Georgia and were previously diagnosed as *Strongyloides stercoralis* of the tropical strain. The morphological similarity that *Rhabditis* bears to the free-living generation of *Strongyloides* appears to have been responsible for much confusion in the past. *Rhabditis hominis* thrives and multiplies prolifically in cultures of feces and other putrifying media and is also reported from soil contaminated with feces. In addition to being found in human feces, the organism was found on a number of occasions in the excreta of animals. Here, as also in the case of man, the worms are not found when the feces are collected under conditions which prevent the entry of free-living nematodes.

Repeated attempts to procure infections with larvae of the species in the human subject have been without success. The evidence which is brought forward indicates that *Rhabditis hominis* cannot even temporarily become established as a parasite in the alimentary canal. The organism is therefore to be regarded as a free-living saprozoic species which appears in the feces as a result of contamination with soil or is introduced by filth flies.

86. *The viability of hookworm eggs in stored night-soil.* (15 min.) N. R. STOLL, Johns Hopkins University. (Introduced by W. W. Cort.)

A large series of experiments on the viability of hookworm eggs in human excrement stored as fertilizer, according to the wet method, were carried on in Soochow, China, from July 1, 1923, to October 15, 1924. By the use of a dilution egg-counting method it was possible to follow the death rate of the eggs in the stored material quantitatively. It was found that under the conditions of storage the eggs did not hatch, but usually remained in early stages of development. Temperature was found to be a very important factor in influencing the length of life of the eggs. In the hottest part of the summer the eggs were found to die off in less than two months. In cooler weather the period is some

what increased. Since night-soil in China is often stored for periods from three to six months, it appears as if regulated storage might be utilized as a control measure. A series of experiments was made in which lime was introduced into the storage containers. It was found that dilution up to 1-500 would kill the hookworm eggs.

87. *The larval trematode infestation of fresh-water molluscs of San Juan Island, Puget Sound.* (Lantern; 10 min.) HARRY M. MILLER, JR., Washington University. (Introduced by Caswell Grave.)

In a survey of the larval trematodes of the fresh-water molluscs of San Juan Island, 718 individuals were examined and a large number of larval trematodes were found. The snails belonged to the genera *Lymnaea*, *Physa*, *Planorbis*, and *Succinea*, representing probably seven species and varieties; a number of bivalves of the genus *Sphaerium* complete the list of available hosts examined. Attention was centered chiefly on the furcocercous larvae, although all infestations were recorded. *Lymnaea stagnalis* harbored five species of cercariae, three new, including one furcocercous form, and two furcocercous species hitherto reported only from northern Michigan; together these infested 65 per cent of the individuals examined. Two, and perhaps three, very small species of the genus *Planorbis* harbored a remarkable fauna of at least ten species of larvae. Of these four are furcocercous forms with the possibility of a fifth species, which would bring the total number to eleven. Forty-two per cent of all individuals examined were infested. Two species found in *Lymnaea reflexa* bring the total number of cercariae up to at least seventeen. There are only three small lakes on the island, two of them connected, and a few small streams. The island is isolated from the mainland by strong tides, and the vertebrate fauna is limited. Consequently, it is thought that these larvae offer attractive material for life-history investigations.

88. *Some new parasites of the Bermuda Echinoidea.* (Charts; 10 min.) RUTH JANE BALL, University of Vermont. (Introduced by Henry F. Perkins.)

Details of structure of five new species of ciliates, heavily infesting the gonads and alimentary tracts of four Bermuda Echinoidea, have been described, drawn, and names for each form proposed.

The largest is a heterotrichous ciliate with hooked anterior measuring 0.16 mm. in length. It is closely allied to *Metopus* and is found in both *Diadema* and *Echinometra*.

A scoop-shaped, heterotrichous form with rudder-like style was found in abundance in *Toxopneustes*. Closely allied to this, but about half as large in size, is a form found only in *Echinometra*.

Holotrichous, cigar-shaped ciliates, measuring 0.16 mm. in length, were found in *Toxopneustes* and *Echinometra*. These were filled with peculiar oval refractive bodies.

The fifth and smallest form only 0.035 mm. in length, was found in *Toxopneustes* and *Hipponeoe*. This is oval in shape and resembles a canoe from lateral aspect.

Three of these parasites were seen in transverse fission.

In addition to a description of each species, something of the differences in structure of protoplasm, locomotion, character of cilia, and degeneration of oral apparatus will be included in this paper.

89. *The fundamental tissue reaction in kala-azar.* (Lantern; 15 min.) HENRY EDMUND MELENEY, Peking Union Medical College. (Introduced by R. W. Hegner.)

A histological study of the organs of nineteen hamsters (*Cricetulus griseus* M.-Edw.), experimentally infected with kala-azar, shows a specific tissue reaction involving exclusively the cells of the 'reticulo-endothelial apparatus.' The duration of infection ranged from six to 455 days.

Soon after the parasites can be demonstrated in the tissue, there develops a proliferation of the endothelial cells of the liver, spleen, and lymph nodes, and of the clasmatocytes in the reticulum of the spleen, lymph nodes, and bone-marrow, which is out of proportion to the apparent intensity of infection. Definite masses of 'clasmatocyte tissue' appear, which gradually replace portions of the normal tissues of these organs. At first only a few of the cells making up these cell masses contain Leishman-Donovan bodies, but gradually all the cells become parasitized. The tissue reaction is best seen in infections of moderate severity. When the infection becomes very intense, heavily parasitized cells occupy practically the whole reticulum of the organs involved, thus hiding the typical picture. Proliferation of endothelial cells seems to be chiefly by mitosis, while that of the clasmatocytes seems to be mainly by direct cell division.

This tissue reaction is fundamentally the same as that produced by the repeated intravenous injection of non-toxic particulate suspensions, such as India-ink, but is more intense, probably because of the continual proliferation of the Leishman-Donovan bodies over a long period of time without causing the death of the host.

ECOLOGY

90. *A sun porch and other equipment for studying the influence of environmental factors on egg production.* (15 min.) H. D. GOODALE, Mount Hope Farm, Williamstown, Massachusetts.

The recent solution of the problem of 'weak legs' in chickens makes possible large changes in poultry management with much greater control of environmental factors than has been possible hitherto. A sun porch that gives complete access to all the sun there is at every season is described and illustrated. A building with cemented yards will, it is hoped, make great improvement in the control of certain parasites hitherto unconquered and permit the securing of quicker and better growth of the birds. Illustrations of this building will be shown.

91. *The growth of turtles fed on rations of pure foods.* (Lantern; 15 min.) A. S. PEARSE and S. LEPKOVSKY, University of Wisconsin.

Painted turtles, gopher turtles, and terrapins were kept warm and continually supplied with more food than they consumed for a year. Lots fed on mixtures of casein, dextrin, cod-liver oil, yeast, salts, and sand increased in weight when the rations were 'complete' in regard to vitamines content, but lost when they were not. On rations of natural foods (lettuce, egg, meal-worms) turtles did not lose weight and in many cases gained—in one instance as much as 75 per cent. The water, ash, nitrogen, and fat in the body of each turtle at the end of the experiment have been determined.

92. *Further studies in correlation of shape and station in fresh-water mussels.* (Lantern; 12 min.) N. M. GRIER, Dartmouth College, and J. F. MUELLER, University of Illinois.

Lake Pepin is an expansion of the Mississippi River below Saint Paul presenting many of the characteristics of large and true lakes. Mussels collected there and in the river above and below were measured for possible correlation of shape and station. *Lampsilis siliquioidea* Barnes, *Eurynia recta latissima* Raf., *Amblema peruviana* Lam., *Lampsilis ovata ventricosa* Barnes, *Lampsilis anodontoides fallaciosa* Smith, *Lasmigona complanata* Barnes, exhibited a greater obesity (dextrosinistral diameter) in the river below Lake Pepin than above. Associated with these changes is a greater dorsal ventral diameter in the upper river of *L. siliquioidea* and *Eurynia*. The inflation of *Fusconaja flava undata* Barnes, *Elliptio dilatatus* Raf., *Strophitus edentulus* Say, *Quadrula verrucosa* Raf., *Obovaria olivaria* Raf., and *Fusconaja ebenus* Lea was more marked above Lake Pepin than below it, and with this is associated greater dorsal ventral diameter in *F. undata*, *E. dilatatus*, *Q. verrucosa*. Lake environments are known to be conducive to a greater dextrosinistral diameter in certain species. *F. undata*, *A. peruviana*, *L. ventricosa*, *L. anodontoides*, *L. complanata*, *E. dilatatus*, *Proptera alata* Say, *Leptodea fragilis* Barnes, *Oblivaria reflexa* Raf., *Truncilla truncata* Raf. were found to be more inflated in Lake Pepin than in the river below. Associated with this is a greater dorsoventral diameter in the lower river compared with Lake Pepin, of *L. fragilis*, *P. alata*, *L. fallaciosa*, *L. complanata*. Many shells obtain their maximum inflation in the lower stretches of rivers, so the changes indicated for certain species seem to be due to the lake-like environment. It should be remembered that at present conditions immediately below Lake Pepin are unfavorable to mussel life, which may account indirectly for the phenomena observed.

93. *Entomostraca from the Panama Canal Zone.* (Lantern; 15 min.) G. S. DODDS, West Virginia University.

The material which forms the basis of this paper was collected by the author during the past summer while in residence at the Barro Colorado Island Laboratory of the Institute for Research in Tropical America. The collections include material from Gatun and Miraflores Lakes, four reservoirs of the Canal Zone, and numerous ponds, marshes, and streams. Special attention will be given to the ecological conditions of these various fresh-water bodies, especially to those which owe their origin to the construction of the canal.

94. *Further studies on Michigan Bog Lakes.* (Lantern; 15 min.) MINNA E. JEWELL and HAROLD BROWN, University of Michigan Biological Station and Kansas State Agricultural College.

A comparative study was made of twelve Michigan Bog Lakes. The dissolved oxygen content of the surface waters of these lakes varied from 2.66 to 5.88 cc. per liter, the oxygen-consuming capacity from 12.4 to 47.66 ppm., and the hydrogen-ion concentration from pH 4.2 to pH 9.0. No correlation was apparent between these various factors nor between the pH and depth, marginal vegetation, or probable age of the lakes.

Fishes were found in waters from pH 4.4 to pH 9.0; snails from pH 6.2 to pH 9.0, and sponges from pH 5.0 to pH 9.0.

Preliminary experiments in transplantation of fish from basic to acid waters and conversely seemed to show a high degree of resistance in the fishes studied to great changes in hydrogen-ion concentration.

95. Measurement of physical factors in the tropical rain forest of Panama.
(Lantern; 15 min.) W. C. ALLEE, The University of Chicago.

These measurements were made during January-March, 1924, on Barro Colorado Island in the Canal Zone during the dry season.

There is extremely little variation in barometric pressure.

The evaporation of water was four times as great over Gatun Lake and twice as great in the jungle roof as on the forest floor.

The air movement near the forest floor was found to be about a mile a day, while that in the jungle roof was ten times as great and over near by Gatun Lake was 240 times as great.

The extreme temperature variation observed on the ground was 6.5°C. Eighty-six feet higher it was 16.5°C. When no sunfleck came near the ground thermometer the week's temperature graph showed less variation than in my thermostat-regulated room in Chicago in May.

A marked vertical light gradient exists. The shade gradient in one series ran from 8800 candle feet in the forest roof to 200 candle feet on the jungle floor. The light intensity in the lower forest is approximately that of an Indiana beech woods in early September. Noon light varied from 402,000 candle feet for direct sun to 11 candle feet in a dense monkey cap palm forest. Sunlight readings were usually less than for midsummer in Utah.

The series of measurements shows that the lower tropical rain forest presents remarkably constant environmental conditions.

96. The classified continuation card catalogue of the bibliography of fishes.
(10 min.) E. W. GUDGER, American Museum of Natural History.

Volume III of the Bibliography of Fishes, embracing the literature through 1914, was published in November, 1923. Having learned how to make a bibliography while serving as editor of this volume, I feel that I owe it to the scientific world to make use of this knowledge by carrying on this Bibliography in the form of a continuation classified card catalogue. This has been done to the point of checking, making, and distributing cards for titles in the Zoological Record, including the last volume issued. In addition, various periodicals have been checked from 1914 on and many separates that have come in have been listed and their special bibliographies checked. This gives us probably 50 per cent more references than are found in the fish sections of the Zoological Record.

As opportunity permits, the Archiv für Naturgeschichte, Concilium Bibliographicum, etc., will be checked. In addition, it is planned to check all the biological serials since 1914 and the special bibliographies in various outstanding papers. Sooner or later, we will have in the office of the Department of Ichthyology of the American Museum a complete classified card catalogue of the literature of fishes since 1914. We cannot send these data out by letter to

inquirers, but anyone calling at the Museum will at once have the literature since 1914, bearing on any particular subject, put in his hands.

I purpose shortly issuing a request to students of fishes all over the world to send in separates that they may be immediately carded and made available to workers in America without waiting to check the yearly bibliographies which commonly appear about two years later than the material which they index.

97. *A limnological study of Hydra oligactis in Douglas Lake, Michigan.* (Lantern; 10 min.) PAUL S. WELCH AND HELEN A. LOOMIS, University of Michigan.

The immense hydra population (*Hydra oligactis* Pallas) which is so conspicuous in Douglas Lake, Michigan, in spring and early summer regularly disappears from the surface waters after a decline period of varying length. Studies of surface-water temperatures and hydra decline extending over seven seasons indicate that the permanent rise, for the season, of the daily maximum temperature above approximately 72°F. and the daily minimum above approximately 68°F. was accompanied by a perceptible hydra population decline. These and other evidences showed that temperature was a very influential, if not the determining factor, in the disappearance of the hydra. Field tests and laboratory experiments likewise showed that during late summer and early autumn the deeper water above the thermocline presents no conditions unfavorable to hydra; that these hydra require a dissolved oxygen content of the surrounding water of at least 0.3 cc. per liter; that the lower part of the thermocline marks the lowest limit of possible habitability during the later part of the summer stagnation period; and that in aquaria maintained in favorable temperatures conditions of reduced food supply may result in a downward migration and subsequent muck feeding similar to that described by Wilson ('91). While conditions of both deep water and bottom above the thermocline appear to be favorable for hydra, the extent to which these situations are inhabited is as yet unknown.

98. *The distribution of the oilfish, Ruvettus pretiosus, in the Pacific Ocean, as shown by the distribution of the peculiar hook used in its capture.* (Exhibit; 15 min.) E. W. GUDGER, American Museum of Natural History.

The history of this fish in the Atlantic is as follows: It was described by Cocco in 1829 and figured by Cantraine in 1837 from the deep waters of Messina, and also described from Madeira by Lowe, from Cuba by Poey, and from the Grand Banks of Newfoundland by Goode and Bean.

In the Pacific it was first taken at Funafuti, Ellice Islands, in 1896; a few specimens have been reported from the markets in Honolulu and Tokio, and we have accounts of its capture by Becke, Krämer, and others at various atolls. Lastly, Weber, in the Siboga Expedition, described a new species from the Banda Sea.

This gives the actual facts of its distribution as revealed by its capture. However, this fish is taken in the central Pacific on a peculiar wooden hook, the most highly specialized hook known to me and as marked an ethnological feature of this region as is the boomerang of Australia. I have spent some months in the study of this hook, its variations in form, and its distribution. In Polynesia it is in use in the Ellice Islands, Union Group, Paumotu, Samoa, Society Islands,

and New Zealand; in Micronesia, in the Gilberts, and the Mortlock Group; in Melanesia, in the Solomons, Mortlocks, Ontong Java, and Nissan. This gives an east-west distribution from the Paumotus to Tagula, a distance of 66°, or 4,400 miles. The north-south distribution reaches from Maraki in the Gilberts to central New Zealand, a range of 42°, amounting to 2,750 miles.

Here, the distribution of the hook gives us an infallible means of tracing the distribution of this little-known fish—little-known, because it must be fished for in waters from 80 to 300 fathoms deep and it can only be taken in the dark of the moon.

99. *Additional observations on the fouling of ships' bottoms.* (10 min.) J. PAUL VISSCHER, U. S. Bureau of Fisheries. (Introduced by S. O. Mast.)

Data gathered from the study of more than 200 ships have been tabulated and show that the organisms occurring most frequently on the bottoms of marine vessels are Algae, Hydroids, and Barnacles. Almost all of the organisms found belong to groups of organisms which are typically found on rocks or other submerged structures near shore. This would substantiate a previous conclusion that fouling occurs when ships are in harbor. Light has been found to be a very important factor in the attachment of the larvae of the various forms which have been found on the bottoms of various ships.

100. *A preliminary study of the mice of Mount Desert Island.* (10 min.) BEATRICE W. JOHNSON, University of Maine. (Introduced by C. C. Little.)

In 1473 trap nights (number of traps in a region $\times$ number of nights they were left in that region) fifty-three mice were trapped. These were of three genera: *Peromyscus canadensis* (the deer- or so-called white-footed mouse), 11♂, 6♀; *Eutamias gapperi* (the red-backed mouse or vole), 22♂, 8♀, and *Microtus pennsylvanicus* (the ordinary meadow mouse), 5♂, 1♀.

The mice were so distributed as to coincide with the presence of available moisture.

There was a significant excess of males over females trapped (38♂, 15♀).

Of the three genera trapped, it is probable that on Mount Desert Island *Peromyscus canadensis* (deer-mouse) lives in the higher altitudes (700 feet); at intermediate levels (150 to 250 feet) there was an overlapping of this genus with *Eutamias gapperi* (red-backed mouse), and at the lowest trapping regions (40 feet above sea level) only *Eutamias* and *Microtus* (meadow mice) were found. *Eutamias* and *Blarina brevicauda* (mole-shrew) were found competing in the same environment.

Deer- and red-backed mice can be retrapped, a total of 105 retraps having been obtained. Meadow mice were never retrapped.

Peromyscus and *Eutamias* are both diurnal and nocturnal.

From trap records it seems likely that within a region, each genus has its own community life instead of being divided into small monogamous families.

A female *Peromyscus* can be introduced into a strange community and survive.

Small mammals can be retrapped, and thus their range distribution or other factors studied.

101. *Seasonal succession of animals in a chara-cattail pond.* (Lantern; 15 min.)
WALBURGER PETERSEN, University of Chicago. (Introduced by W. C. Allee.)

Seasonal succession at six stations in a chara-cattail pond was followed, usually at weekly intervals, for a year. The animals showed spring and late fall maxima, with winter and late summer minima. The succession in the pond in general order of appearance in spring was Crustacea, gilled snails, pulmonate snails, insect nymphs, larvae, and adults. Those animals which appeared first in spring tended to disappear last in the winter, and vice versa.

The oxygen content increased from fall to the time of the freeze, decreased to the time of the thaw, rose until a water temperature of 20°C. was reached, fell steadily until late summer when the water was low, and then rose as the water became higher. The pH followed in general the same course as the oxygen. Water temperature steadily decreased in the autumn till the freeze, increased after the thaw, fluctuated in the summer, and became lower in late summer. Ice left little free water in the pond in winter, and there was also a period of low water at the time of the summer minimum.

The data indicate that the general seasonal succession of animals is caused by temperature-water level conditions, and that pH and oxygen tension are accompanying rather than causal factors.

GENETICS

102. *The mode of expression of factors influencing carbohydrate storage in the endosperm of corn.* LOIS LAMPE and MARION T. MEYERS, Ohio State University.

Globules of cytoplasmic origin whose liquid portion apparently is a dextrin, since it stains red with iodine, is precipitated by alcohol, and is digested by diastase, recently have been found in the immature endosperm of sweet corn.

Consequently, carbohydrates are stored in the endosperm of corn in five different ways, namely, 1) in large simple grains of starch in starchy corn; 2) in similar appearing large simple grains which stain red with iodine in waxy corn; 3) in grains of starch, the larger of which are compound, in ordinary sweet corn; 4) in similar-appearing compound grains which stain red with iodine in waxy-sweet corn, and, 5) in the above-mentioned globules which are present in both kinds of sweet corn.

Which of these five kinds of carbohydrate storage will obtain is determined by the interaction of the two allelomorphic pairs of factors, *Su su*, *Wx wx*. The presence of the dominant factors of both pairs *Su* and *Wx* is necessary for the development of the large simple starch grains. The recessive *su* conditions the development of the globules and the compound nature of the larger grains in the endosperm of sweet corn, whether it is *Wx* or *wx*. The recessive *wx* conditions the development of the grains of carbohydrate in such a way that they stain red with iodine instead of blue, regardless of the factor pair *Su su*.

103. *Cytology of certain potato species and varieties.* HUGH B. SMITH, Maine Agricultural Experiment Station, Aroostook Farm, Presque Isle, Maine.

Preliminary counts of the chromosomes in certain wild species of potato show that the haploid number in *Solanum chacoense* and *S. jamesii* is 12; in *S. fendleri* it is more than 20, but less than 30, and in *S. demissum* it is more than

30, but less than 40. The F_1 hybrid between *S. fendleri* $\times$ *S. chacoense* and the form known as *S. maglia* have lagging chromosomes at the first heterotypic division, but the chromosome number of these two forms has not been determined. The two cultivated varieties known as Green Mountain and Early Ohio have a haploid chromosome number of 24 ± 1 . In the Early Ohio variety lagging chromosomes are evident at the first heterotypic division, but whether or not Green Mountain has lagging chromosomes has not been definitely determined.

104. *Some evidences of hybridity in Typha.* MURIEL V. ROSCOE, 61 Garden St., Cambridge, Massachusetts.

Typha in the Eastern States is ordinarily considered to be represented by two species, namely, *Typha latifolia* and *Typha angustifolia*. A study of forms occurring where the two species range together suggests that intermediates between the two types arise.

These intermediate forms have neither the broad leaf of *Typha latifolia* nor the narrow leaf of *Typha angustifolia*; these, in addition, show all gradations in the length of the interval separating the pistillate and staminate parts of the spike, whereas *Typha latifolia* has such regions usually continuous and *Typha angustifolia* is the species characterized by an interval.

The adult pollen of the intermediate forms manifests a striking degree of sterility; loss of protoplasmic contents and the development of a shriveled appearance by the majority of the adult grains are apparent. The morphologically poor pollen developed by hybrids has long been considered significant.

The nuclear conditions in *Typha* will also be described.

Typha as a hybrid will be considered on the basis of, a) external appearance, b) pollen conditions, c) nuclear manifestations.

105. *Chromosome behavior during meiosis in the pollen mother cells of certain Oenotheras.* RALPH E. CLELAND, Goucher College, Baltimore, Md.

Meiosis has been studied in the pollen mother cells of eleven species of *Oenothera*. At the end of the heterotypic prophase, the chromosomes are arranged in the nucleus according to certain schemes, as follows: *Oe. franciscana*, a closed circle of four univalent chromosomes and five pairs; *Oe. franciscana sulfurea* and *Oe. lamarkiana*, a circle of twelve chromosomes and one pair; *Oe. biennis* and *biennis sulfurea*, a circle of eight chromosomes and one of six; *Oe. oblonga*, a circle of five chromosomes and five pairs (certain modifications of this scheme also being found); *Oe. muricata*, a circle of fourteen chromosomes; *Oe. rubrinervis*, a circle of six chromosomes and four pairs (probably); *Oe. rubricalyx*, a circle of eight chromosomes and three pairs; *Oe. deserens* and *blandina*, seven pairs. Evidence is advanced in favor of a fixed arrangement of the chromosomes within circles also. In the heterotypic metaphase the circles remain intact. Alternate chromosomes, as a rule, are drawn toward the same pole. This insures an equal distribution to the poles. Also if chromosomes are definitely arranged within the circles, the same chromosomes will go to the same pole in all cells, and genetical linkage will be the result.

106. *The probable cytological basis for certain genetical peculiarities of Oenothera.*

RALPH E. CLELAND, Goucher College.

Two cytological facts are emphasized: 1) The chromosomes are arranged according to a definite pattern in all pollen mother cells of a given species. This applies to their arrangement within the circle as well as into circles and pairs. 2) Alternate chromosomes in the circles go, as a rule, to the same pole, but irregularities may occur.

The following conclusions are drawn: 1) Failure to pair is probably due to heterozygosity. Ability to pair implies relative homozygosity. Circles may have originated as a result of hybridization, or of the sudden appearance of large mutations, or more likely as the result of a balanced lethal condition. 2) The cytological reasons have apparently been found for the extensive linkage of characters, the existence of only two types of gametes in many *Oenotheras*, and the fact that the chromosome complexes found in these two types are the same as those which came together in the first place to form the plant. 3) Crossovers can be largely, perhaps wholly, explained as due to the observed irregularities in chromosome distribution in the first maturation division. 4) A cytological explanation can be given for the appearance of certain mutants.

107. *Genetics of four groups of seedling characters which affect the development of chlorophyll in maize.* M. DEMEREC, Station for Experimental Evolution, Long Island, New York.

Genetic investigations made with many seedling characters obtained from different varieties of maize showed that several of these, though phenotypically similar, were determined by genetically different factors. Four groups of phenotypically more or less indistinguishable characters are as follows:

1. Virescent seedlings, which are practically devoid of chlorophyll in the early seedling stage but become greener with age, and at maturity cannot be distinguished from other green plants. Inter-crosses thus far completed show the existence of five genetically different factors for virescent ($V_1V_1-V_5V_5$). All of them are simple mendelian recessives to green.

2. Pale green seedlings. Six of these have been found by inter-crosses and indirect tests to be determined by independent simple mendelian recessive factors. They differ in the chlorophyll content— pg_1pg_1 (described by A. M. Brunson) having 15 per cent; pg_2pg_2 , 53 per cent; pg_3pg_3 , 30 per cent; pg_4pg_4 , 40 per cent; pg_5pg_5 , 70 to 80 per cent, and xantha (described by H. Trajkovich) about 10 per cent of normal chlorophyll. All of them but pg_2pg_2 and xantha are lethal.

3. Piebalds, having irregular white or yellowish spots in the seedling stage which may or may not disappear with age. Four factors for piebalds were determined, two of them (Pb_1pb_1 and Pb_4pb_4) being simple mendelian recessives and the other two (Pb_2pb_2 and Pb_3pb_3) being duplicate genes.

4. Zebra seedlings and plants, which have transverse zebra-like stripes throughout the leaves. Inter-crosses show the presence of four simple mendelian factors for zebra ($Ze_1ze_1-Ze_4ze_4$) in the material used in the investigations.

108. *Inheritance of white seedlings in maize.* M. DEMEREC and R. A. EMERSON, Station for Experimental Evolution and Cornell University.

Investigations were begun with twenty-seven unrelated families of maize throwing white seedlings, and up to the present time fifty-five successful intercrosses have been made. F_2 generations have been grown from twenty-two of these crosses. Contrary to expectation, intercrosses indicated that with one exception white seedlings in cultures used in intercrosses were genetically different. In the one case, i.e., a cross between a variety of sugary maize and a flint variety, the F_1 generation gave white seedlings. Considering F_1 as well as F_2 data, the intercrosses indicate the presence of at least ten factors for white seedlings. Five of these are simple mendelian factors, four of them make two sets of duplicate genes, and probably at least one additional factor can be obtained from a set of triplicate genes, for which, however, one intercross is lacking to complete all possible tests.

109. *The nature of gene changes to form multiple allelomorphs.* W. H. EYSTER, University of Maine.

Multiple allelomorphs have been found in many plants and animals that are being studied genetically. This fact indicates that genes undergo more than one kind of change so as to produce a series of effects, any two of which behave as allelomorphs. The orthogenetic nature of practically all known multiple allelomorphs indicates that they are due to quantitative changes within the gene. Genes for color variations in plants and animals undergo different kinds of changes with sufficient frequency to make possible a study of the nature of the gene changes involved.

Variigated maize is especially adapted for study because of, 1) the large number of allelomorphs that are produced; 2) the high frequency with which the changes occur, and, 3) the ease with which an abundance of suitable material can be produced. The results strongly indicate that a variegation gene is produced when contrasting elements are incorporated in the structure of the same gene. The allelomorphs that appear in a variegation series are due to, 1) a structural rearrangement of the same gene elements, and in this respect are like isomeres in organic compounds, and, 2) to structural arrangements involving different relative amounts of the contrasting gene substances. There is no evidence in support of the idea that the variegation gene is due to imperfect segregation in a heterozygote between white and red pericarp.

110. *The effect of environment on variegation pattern.* W. H. EYSTER, University of Maine.

Strains of variegated maize of the same genetic constitution were grown in different regions to determine the effect, if any, of the different environmental conditions on the frequency and kind of change undergone in the gene for variegated pericarp. Ears that developed in a cool, moist climate with a long growing season have a fairly coarse pattern with all of the pigment segregated into definite areas in the form of splashes, lines, and larger segments of a kernel, while the remainder of the kernel's surface appears free from color. Ears of the same genetic constitution, but grown in a region with a hot, dry

climate and having therefore a shorter growing season developed a strikingly different pattern with some of the pigment segregated into smaller areas, while some of the pigment appears to remain diffused throughout all of the pericarp tissue. The result is a fine pattern on a washed-out-red background. Changes to self red occurred more frequently in the pericarp developed in the cool, moist climate. Since a variegation is the result of the somatic segregation of contrasting (pigment-producing and non-pigment-producing) elements within the same gene, the observed differences in pericarp pattern indicate the environmental differences, and in this case probably temperature, delay the initiation or rate of intragenal segregation. Plantings from ten different ears produced consistent results.

111. Modification of a mendelian ratio by altering the conditions of pollen tube growth. R. A. BRINK, University of Wisconsin.

A comparison was made of the proportion of starchy and waxy seeds produced when two groups of sister maize plants differing in style length and heterozygous for the waxy gene were selfed. It was found that 23.96 ± 0.49 per cent of the seeds were waxy when the pollen was applied to silks trimmed off near the tip of the ear, whereas only 20.43 ± 0.82 per cent of waxy grains resulted when long silks were pollinated at their outer tips. Irradiation of pollen from heterozygous plants with ultra-violet light for fifteen, thirty, and forty-five minutes did not occasion a significant change in the proportion of waxy and starchy seeds. Desiccation of the pollen over CaCl_2 for one hour at 40°C . gave 3.19 ± 1.07 per cent fewer waxy seeds than found in the check series.

Reduction in extent of the gametophyte generation in the great plant groups reaches its culmination in the angiosperms. The opportunity for selective action between sporogenesis and fertilization, however, is not wholly eliminated in this division. The development of the male gametophyte brings into play certain genes governing fundamental physiological processes, and if these factors differ in competing individuals the distribution of the various classes of male gametes presented at fertilization may not concur with the proportion in which the different types of microspores are formed at reduction.

112. Daily variation in crossing-over in maize. L. J. STADLER, University of Missouri.

The characters used were aleurone color (*C*), shrunken endosperm (*sh*), and waxy endosperm (*wx*). The usual cross-over values are about 4 per cent for the *C-Sh* section and about 20 per cent for the *Sh-Wx* section. Interference in this region is exceptionally high.

Repeated pollinations from five plants throughout the pollen-shedding period showed distinct and significant differences between the cross-over percentages for different plants, but no more fluctuation between different determinations for the same plant than would be expected to result from random sampling. There was no appreciable increase or decrease in crossing-over with age. Cross-over determinations made by pollinating from the main tassels and from tiller tassels (five to ten days later) in a larger number of plants also showed no significant difference.

113. *Factors influencing the rate of crossing-over in maize.* G. N. COLLINS, United States Department of Agriculture.

Crossing-over of the genes *Wx* and *C* for the characters endosperm texture and aleurone color ranges from 10 per cent to 45 per cent. Variations in crossing-over in the formation of female gametes are associated with the position of the inflorescence on the plant and the position of the flower on the inflorescence. In the formation of the male gametes crossing-over is less in plants heterozygous for the complimentary factor *R*. There are significant differences in the crossing-over of male and female, but these differences are usually masked by the action of other factors.

114. *The inheritance of quantitative characters.* KARL SAX, Maine Agricultural Experiment Station.

The inheritance of size differences can best be analyzed by a study of size factors which are linked with simple qualitative factors. In certain bean hybrids factors for seed size were found to be linked with factors for pattern, color, and pigmentation of seed coat. Total yield per plant was also found to be linked with the mottling factor. Similar results were obtained with sweet-corn hybrids. Dwarf Crosby, a variety with very small ears and white grain, crossed with Golden Bantam, a variety with comparatively large ears and yellow grain, resulted in the usual 3:1 ratio of yellow and white grain in F_2 . The F_2 plants were classed as homozygous yellows, heterozygous yellows, and whites. The yellow segregates of both classes were significantly larger than the whites. The homozygous yellow segregates were almost as large as the heterozygous yellows, indicating partial dominance of the factor or factors for large size in the linkage group containing the factor for yellow seed color.

115. *A possible case of selective fertilization in maize hybrids.* R. A. EMERSON, Cornell University.

Crosses of the common varieties of sugar corn with most types of starchy corn give 25 per cent of sugary seeds in F_2 , with typical mendelian behavior in later generations and in backcrosses. When, however, rice pop-corn is used as the starchy parent, there results in F_2 a marked deficiency (about 15 per cent) of sugary seeds. F_2 progenies from starchy seeds of this cross again throw low-sugar ratios, but with them normal (25 per cent) and occasionally high-sugar (35 per cent) ratios. In backcross tests, common sugar $\times F_1$, $F_1 \times$ common sugar, and $F_1 \times$ low sugar give approximately a fifty-fifty segregation, but low sugar $\times F_1$ shows only about 30 per cent sugary seeds. Low-sugar strains $\times$ rice pop give 25 per cent sugary in F_2 , while low sugary $\times$ other starchy types give high sugary in F_2 . These results are interpreted as due to a factor from rice pop, linked with the starchy-sugary genes, which influences rate of pollen tube growth, thus resulting in selective fertilization. In attempts to check the hypothesis, linkage tests and pollination experiments with mechanical mixtures of pollen have been tried.

116. *Preliminary announcement of a cytological and a genetical study of Petunia.*

MARGARET C. FERGUSON, Wellesley College.

It was decided in 1919 to use the *Petunia* as the basis for study in the course in cytology and genetics in Wellesley College.

The number of chromosomes is clearly seven and fourteen. Present evidence points to telosynapsis. An unrecorded method of double fertilization is characteristic of all forms studied.

Certain strains apparently homozygous for color have now been derived, and reciprocal crosses between them, as also between them and the wild *P. nyctaginifolia*, are being investigated. In so far as the study of color has progressed, there is distinct evidence that it is a mendelian factor. But as the derivation of homozygous strains for color has thus far formed the chief basis of study, from the genetical standpoint, the behavior of color in hybrids has not sufficiently progressed at this time to warrant a fuller discussion of its inheritance.

Spotting, apparently unlike the flaking, etc., described for plants, is under investigation.

Problems in sterility have also arisen and are being studied. A rather uniform seasonal sterility has been in part overcome by the use of artificial light. Certain cultivated strains have proved absolutely self-sterile under ordinary treatment. When cultivated strains are used as pollen parents in crosses with the wild *P. nyctaginifolia*, marked fertility results; but absolute sterility results with the wild species as the pollen parent.

117. *Hybridism in the quill-worts.* E. C. JEFFREY, Harvard University.

In collecting during the past summer, the author's attention was attracted by extraordinarily large specimens of *Isoetes*. These grew side by side with two species of normal size. On examination, the gigantic forms manifested a high degree of sterility in both their microspores and megaspores. More recently it has been possible to subject the material to cytological investigation, and the result shows that the gigantic forms in question are unquestionably hybrids. On the following grounds their hybrid origin is indicated: 1) Gigantism. 2) Sterility of both microspores and megaspores, in some cases, leading to almost complete abortion. 3) The cytological features which accompany hybridism, namely, irregularities in mitosis involving lagging chromosomes both in the anaphase and metaphase.

118. *Selection for self-compatibility in five generations of Brassica pekinensis.*

A. B. STOUT, New York Botanical Garden.

In a mixed population of Chinese cabbage (*Brassica pekinensis*) a few plants were found to be self-compatible in fertilization. Progeny of these were grown and selection of seed parents having a high degree of self-compatibility was continued for five generations. In some generations over 1000 plants were grown and tested. The results from year to year in a single line of descent were decidedly variable, but in every line in the fifth generation a considerable number of plants were completely self-incompatible. In no case was a line of progeny of only self-compatible plants obtained.

119. *Breeding evidence for constant chromosomal types among wild races in Datura.* A. F. BLAKESLEE, GORDON MORRISON, and BETTY P. WATT.

The genes for purple and white have been shown to be located in the Poinsettia chromosome by the trisomic ratios thrown by the primary mutant Poinsettia and also by its secondary Wiry when heterozygous for these two factors, while other $(2n+1)$ mutants investigated throw disomic ratios when similarly heterozygous for normal 'A' whites. When, however, the white comes from a certain race ('C' whites), the mutant Rolled also throws trisomic ratios as well as Poinsettia. Furthermore, the mutant Nubbin, which is peculiarly related to Rolled, throws purples and whites in proportions markedly different from disomic ratios when heterozygous for this 'C' white. When duplex heterozygous (Pp_2) for certain other races ('B' whites), Poinsettia regularly throws many more whites than expected. It is uncertain as yet whether 'B' and 'C' whites are different, but experiments are under way to test their possible identity. It is only from parents heterozygous for 'B' and 'C' whites that the secondary Wiry has arisen being thus thrown by Poinsettia, Rolled, and one of the secondaries of Rolled. It is evident that the peculiarity of these abnormal whites is connected with the Rolled chromosome and that it involves the Wiry portion of the Poinsettia chromosome.

120. *The trivalents of different classes of $2n+1$ daturas.* JOHN BELLING and ALBERT F. BLAKESLEE, Station for Experimental Evolution, Cold Spring Harbor, Long Island, New York.

Class I. The trivalents of the twelve members of this class (including one doubtful primary) show no closed V-rings. The majority have the form of an open V, a ring-and-rod, or a Y.

Class II. The trivalents of this class (of which seven mutants have been examined) show usually (except in one case) a preponderance of the closed V-ring.

Class III. In this class (which probably includes four mutants) there is a connection between non-homologous chromosomes. One or more of the chromosomes of a bivalent or trivalent may be attached to another trivalent or bivalent, respectively. A change at one end of one chromosome has apparently occurred.

Class IV. In one mutant a small chromosome is attached to two chromosomes, each double its size. The indications are at present that this small chromosome is a half chromosome; for those measured average smaller than the smallest of the twelve of *Datura stramonium*.

Class V. In one $(2n+1)$ mutant, the four trivalents seen consisted apparently of two equal chromosomes and one of double the size. This may, however, belong to class III.

121. *New flower colors in Oenothera and their genetical behavior.* GEORGE H. SHULL, Princeton University.

In 1921 a new flower-color mutation, vetaurea (old-gold), was discovered in *Oenothera lamarckiana*. In backcrosses to yellow-flowered lamarckiana 'old-gold' is a typical mendelian recessive like the short-styled mut. brevistylis. 'Old-gold' crossed with mut. sulfurea, produces a yellow-flowered F_2 , showing that yellow

is a compound character produced by the interaction of complementary factors, *V* and *S*. The *S* (sulfurea) factor is linked (group I) with many other known factors: dwarf stems, revolute leaves, red hypanthia, red stems, narrow petals, green or red bud-cones, and four or more recessive lethals. The *V* (vetaurea) factor is independent of this big linkage group. It is also independent of brevistylis (group II) and therefore marks linkage-group III. In the absence of lethal factors, 9:3:3:1 ratios are produced in F_2 of crosses between vetaurea and factors of linkage-group I, and between vetaurea and brevistylis (group II). Crosses of sulfur and old-gold yield a fourth flower-color, 'seg. aurata,' or 'pale old-gold' (*vs*), when both *V* and *S* are absent.

Cleland reports in *Lamarckiana* a chromosome complex consisting of twelve chromosomes united end to end to form a ring, leaving one detached pair. If such ring formation is the basis of linkage in the *oenotheras*, the detached pair of chromosomes might be assumed to carry linkage group II, of which *mut. brevistylis* is the marker. A second independent factor argues for a second independent pair of chromosomes. Do different strains of *Lamarckiana* differ in the grouping of the chromosomes?

122. *The inheritance of typical, tufted, and polycladous characters in Sphaerocarpos.* CHARLES E. ALLEN, University of Wisconsin.

Among the offspring of matings of typical $\times$ typical, as well as among those of matings of typical $\times$ tufted and typical $\times$ polycladous, appear some clones of each sex which, while they display no aberrancies not also found in typical clones, seem to show these aberrancies in somewhat larger proportions. Such doubtful clones have hitherto been classed as 'possibly atypical.' Two matings of 'possibly atypical' by typical, and one of typical $\times$ 'possibly atypical,' give gametophytic offspring, of which the great majority are typical and a few may be classed as possibly atypical. It appears, therefore, that the 'possibly atypical' clones are genetically not to be distinguished from the typical clones.

Matings of typical $\times$ polycladous result in sporophytes, the great majority of whose spore tetrads fall into two approximately equal classes. The tetrads of one class produce two typical females, two polycladous males; those of the other class, two polycladous females, two typical males. Rarely (in only one case thus far observed), a tetrad may produce one typical and one polycladous female, one typical and one polycladous male. Matings of tufted by typical give analogous results.

123. *Three new Diptera suitable for experimental work in genetics.* C. L. TURNER, Beloit College.

It is found to be practicable to use three flies for experimental work in genetics which have not been so used. The forms are small and hardy, have short life-cycles (twenty-four days or less), will live and breed upon a simple medium such as decaying vegetation or manure, and are easily reared in the laboratory throughout the year in small bottles or flasks.

1. *Leptocera fontinalis* is about half as large as the house-fly. It completes its life-cycle in eighteen to twenty days. It breeds upon decaying vegetation. A mutation has appeared in the form of a deeply notched wing, and a strain of

the mutant flies has been maintained for eleven generations. A stock of the normal flies has been carried through sixteen generations.

2. A fungus gnat (*Neosciara coprophila*) has been carried through fifteen generations with manure as a medium. The life-cycle is completed in twenty-one days.

3. An undetermined March fly (*Bibio* sp?) has proved to be very favorable. It is exceedingly hardy and will breed in moist earth, decaying vegetation, or manure. The length of its life-cycle is about twenty days.

124. *The salmon-eyed gene in guinea-pigs.* H. L. IBSEN and P. W. GREGORY, Kansas State Agricultural College.

Animals with salmon eyes have eyes that are pink in general appearance, but on closer examination show a ring of dark pigment, varying in width and intensity, surrounding the pupil. The salmon-eyed gene also differs in its expression from the pink-eyed in that, unlike the latter, it does not dilute either black or chocolate pigment. It behaves as a recessive, its allelomorph being necessary in the production of the normal dark eye. The dominant allelomorph of pink-eye (*p*) is also necessary for the production of dark eyes. A homozygous dark-eyed animal may therefore be represented as *PP Sm Sm*; a pink-eyed as *pp Sm Sm*, and a salmon-eyed as *PP sm sm*. When homozygous pink-eyed were mated to homozygous salmon-eyed, twenty-eight offspring, all dark-eyed (*Pp Sm sm*), were produced. When animals heterozygous for both factors were mated together, eight dark-eyed, one salmon-eyed, and eight pink-eyed resulted. The expected ratio is nine dark-eyed : three salmon-eyed : four pink-eyed, because pink-eyed is epistatic to salmon-eyed. Other types of matings furnish additional proof that the mode of inheritance is as above outlined. There is also evidence of a modifying factor (or factors) changing the expression of the salmon-eye to the extent that no pigment appears in the eye, making it resemble a pink-eye. The chocolate or black hair remains intense, however, indicating that the animal is a salmon-eye. In testing the possible linkage relations between pink-eye and salmon-eye, double heterozygotes (*P sm p Sm*) were mated back to double recessives. The numbers obtained are small, but the indications are that linkage does not exist.

125. *New data showing aberrant ratios in the E allelomorphic series in guinea-pigs.* H. L. IBSEN, Kansas State Agricultural College.

It has previously been shown that in matings involving E, complete extension of black or chocolate, *e^p*, partial extension, and e, non-extension, a deficiency of *e^pe^p* offspring is produced in the cross *Ee^p × e^pe^p* and an excess of *e^pe^p* offspring in the cross *Ee × e^pe^p*. In the first cross there were 69 *Ee^p* and 38 *e^pe^p* offspring, while in the second there were 52 *Ee^p* and 101 *e^pe^p*. Other matings showed corresponding deficiencies of *e^pe^p* and excesses of *e^pe^p* animals.

In order to test the matter further, a new series of more carefully controlled matings were made. Each *Ee^p* or *Ee* animal, whether male or female, was mated to both *e^pe^p* and *ee* individuals, while the *e^pe^p* and *ee* animals were mated to both *Ee^p* and *Ee* individuals. *Ee^p* males mated to *e^pe^p* females produced 81 *Ee^p* and 41 *e^pe^p* offspring, while with *ee* females they produced 56 *Ee* and 76 *e^pe^p* offspring. *Ee^p* females $\times$ *e^pe^p* males produced 91 *Ee^p* and 51 *e^pe^p*, but with *ee* males they

produced 65 Ee and 51 e^ee offspring. Ee males $\times$ e^ee^p females produced 32 Ee^p and 48 e^ee. Mated to ee females, they produced 71 Ee and 80 ee. Ee ♀ $\times$ ee ♂ = 59 Ee^p and 52 e^ee. Ee ♀ $\times$ ee ♂ = 58 Ee and 33 ee. The other matings produced similar results. No satisfactory explanation has as yet been found for the aberrant ratios.

126. *Inheritance of hypotrichosis in rats.* ELMER ROBERTS, University of Illinois.

Two wild rats (*Mus norvegicus*), a male and female, devoid of hair except a few scattered over the body, were sent to our laboratory in the fall of 1923. The female died without producing young, but thirty-five young were obtained from matings of the hairless male to stock albino females. All of these young were of the wild gray type.

Before the hairless male died, one litter of six was produced by a back-cross. All of these were normal up to the age of twenty-four days, when it was noticed that five of them were losing their hair, which loss was complete, except for a few hairs, in about ten days, while the other remained normal.

Up to the present time eighty-seven young from F₁'s mated inter se have been produced to an age of at least three to four weeks, when it is possible to classify them in respect to the abnormal condition of the hair. Of the sixty-five, twenty-two have been hairless.

This seems to be a clear-cut case of inheritance of hypotrichosis, and probably only a single factor difference is involved.

An investigation of the cause of this condition has not been made, since the breeding records are desired before any of the hairless animals are sacrificed.

127. *On the number of corpora lutea produced at successive pregnancies by normal and heavily alcoholized mice.* E. C. MACDOWELL and E. M. LORD, Carnegie Institution, Cold Spring Harbor, New York.

A study is being made of the activity of the ovary of the mouse based on the number of corpora lutea of pregnancy. By a surgical technique previously described the corpora lutea at each pregnancy are directly observed, so that a continuous history of every ovary is recorded in terms of the number of ova it contributed toward each litter of young born. This preliminary report is based on the counts of corpora lutea in right and left ovaries obtained in 367 operations on 106 mice. Of these, forty-nine were made dead drunk with alcohol fumes daily for five days a week; fifty-seven were litter-mate controls. For the controls the curve of the average number of corpora lutea at successive pregnancies shows a gradual rise from about eight at the first to nearly eleven at the sixth pregnancy. The corresponding averages for the treated mice form a parallel curve which is higher at every point. The difference at each pair of points taken separately is about the same order of magnitude as their probable errors. Two conclusions may safely be reached from these curves: the decline in litter size normally found in mice after the first two or three litters is due to increasing prenatal mortality, and not to a reduction in the number of ova; extreme alcoholization does not cut down the number of ova brought to maturity.

128. *The occurrence of an eye and of a tooth abnormality in a line of albino rats.*

ELIZABETH JONES, University of Maine.

Modification of the germ cells in albino rats (Wistar Line A) was attempted experimentally. In one litter, following treatment, two abnormal-eyed individuals were produced. This line has been continued, and the abnormality has been found to be transmitted in an irregular fashion.

In this same line, in a later generation, an abnormality of the teeth appeared. This consists of a lack of growth control in the incisors in either or both lower and upper jaws. These teeth grow into long tusks which curl back into the mouth cavity, or outside over the lips. It is also a transmitted characteristic.

No claim is made that these abnormalities are the direct result of the treatment. Their occurrence is recorded, together with a description of the treatment that all those working with the same material may know of their existence. Over 500 controls failed to show either abnormality.

129. *Eye defects in the white rat.* J. A. DETLEFSEN, The Wistar Institute.

A single female appearing in untreated normal stock showed a retinal hemorrhage. Mated to her normal brother, they produced, among others, two abnormals. Various types of mating have produced up to the present time nineteen abnormals in eighty offspring. The abnormalities include opacity of lens, microphthalmia, complete resorption of the eye, retinal hemorrhage, coloboma, and adhesions of iris to lens. Either one or both eyes may be affected or each eye may show differing defects.

Entirely unrelated to the cases just cited, three separate cases appeared in which the entire litter shows microphthalmia and in some cases opaque lenses in addition. These abnormals, when mated together or mated to normals produced only normals in the F_1 generation. The F_1 , mated together, have also given only normals. This latter type of eye defect is therefore not transmitted.

130. *Further data on the inheritance of the sex-linked barred pattern of domestic fowls.* L. C. DUNN, Connecticut (Storrs) Agricultural Experiment Station.

Evidence is presented showing that the typical Barred Rock feather pattern is due to a complex of at least three genes: B, barring; E^m , extension of melanin to all parts of the plumage; S, silver or inhibitor of buff or yellow pigment. By recombination of these genes after crossing, a new type of sex-linked barring is produced, viz., yellow and white barring, in which the black crossbars of the Rock type have been replaced by yellow. Progeny tests show the genotype of yellow-white barring to be $e^m e^m B(b)ss$. It is non-extended, non-silver barred. Barring, therefore, regulates deposition of both black and yellow pigment; and the white spaces in black-white barring are not due to action of the silver gene. These conclusions are in harmony with the recent interpretation of Agar. Results of crossing heterozygous males $E^m e^m BbSs$ with black, barred and buff females show that E^m prevents development of yellow and white barring, and makes it difficult to measure accurately the linkage between B and S. A short résumé of these crosses is given with a comparison of the action of the genes involved in sex-linked barring and in Punnett's autosomal barring.

131. *Genetic and morphological comparison of two kinds of rumpleness in the fowl.* L. C. DUNN and W. LANDAUER, Connecticut (Storrs) Agricultural Experiment Station.

Genetic tests of several rumplless fowls at this station have shown that congenital absence of the tail may be due to two distinct causes: 1) Inheritance of a dominant factor for rumpleness; 2) an accident in embryogeny. Externally the two kinds of rumplless fowls are indistinguishable. Crosses of rumplless fowls heterozygous for the rumplless factor with normal fowls have produced thirty-one rumplless and twenty normal offspring; crosses between heterozygous rumplless have produced nine rumplless and three normal. Crosses of accidental rumplless fowls with normals have produced only normals. Frequency of the accidental rumplless variation in our stock is about one per thousand based on 10,000 chicks observed. In both types of rumplless the oil gland is absent and the caudal vertebrae are either entirely absent or represented by a remnant of one or two. The bones and musculature of the two types are compared briefly with each other and with the normal.

132. *Inbreeding with White Leghorns with particular reference to egg production.* H. D. GOODALE, Mount Hope Farm, Williamstown, Massachusetts.

Inbred matings of various kinds have been made at the farm since 1919, with continued brother-and-sister matings beginning in 1921, which encourages the belief that certain lines will continue to reproduce themselves. Already the lines are exhibiting diverse characteristics such as have been observed from continued brother-to-sister matings in other forms. So far no line has been found where egg production remains at the same level as the family from which it arose, though very good production is being obtained from certain matings. Inter-crosses of the inbred lines point toward higher egg yield than the inbred lines.

133. *A sun porch and other equipment for studying the influence of environmental factors on egg production.* H. D. GOODALE, Mount Hope Farm, Williamstown, Massachusetts.

The recent solution of the problem of 'weak legs' in chickens makes possible large changes in poultry management with much greater control of environmental factors than has been possible hitherto. A sun porch that gives complete access to all the sun there is at every season is described and illustrated. A building with cemented yards will, it is hoped, make great improvement in the control of certain parasites hitherto unconquered and permit the securing quicker and better growth of the birds. Illustrations of this building will be shown.

134. *Linkage relations in the sex-chromosome of the domestic fowl.* D. C. WARREN, Kansas State Agricultural College.

From crosses between the single-comb White Leghorn and the Jersey Black Giant breeds data concerning linkage relations in the sex chromosome have been obtained. The three genes investigated were B (barring), R (rate of feathering), and D (shank color). The crosses, from which the data were obtained, were not made primarily for the study of linkage and, due to the masking effect

of certain characters involved, many of the data could not be used. Data were obtained regarding the relations between B and R and between D and R. When B and R were considered, a total of seventy individuals gave a cross-over value of 47.1 per cent. The genes D and B gave a cross-over value of 48 per cent from a total of 111 individuals. The data here given are much too meager to assign map distances or even determine the relative positions of the genes. However, due to the very loose linkage relations observed, no accurate mappings can be done until genes more closely associated have been located.

135. *The reptilian fowls—a study in atavistic heredity.* I. E. CUTLER, University of Denver.

The peculiar variety of fowls in question, Creepers, Dumbfries or Brevecrows, has been known for hundreds of years, along with the Rumpless, Frizzles, Silkies, and the like, but no one seems to have noticed the peculiarities which are the specific topic of this paper. These abnormalities lie in the appendages, the wings and legs. In both cases the bones are all much shortened, but in the leg, while all the bones are shortened, in the crus or 'drumstick' we find two complete bones. In normal fowls there is one bone, the tibia with a small splint, the fibula. In old specimens these members are strongly ankylosed, especially in the distal portion. In the unequal lengthening of these, the tibia becomes bent forward and thickened. This complete development of the fibula is surely of low reptilian type. Genetically, when these fowls are crossed with normal ones, about 50 per cent will come true to type. When bred inter se, some chicks show a peculiar outward bending of the leg at the hip and knee on one side. In a few both legs show this abnormality, making walking absolutely impossible. Here we have a lacterilian, rather than a dinosaurian, characteristic. It is practically impossible to rear such individuals, so nothing can be said about their progeny. It is possible that some new retrogressive features might develop. It is commonly held that birds sprang from a reptilian stem, probably an offshoot of the dinosaurs. These facts may throw some light on this problem.

136. *The latitude of genetic indetermination of psychic characters in man, as indicated by a case of identical twins reared apart.* H. J. MULLER, University of Texas.

This case (first pointed out by Popenoe) was investigated through a series of mental tests, as given by Dr. Helen Koch, in Texas, to twins reared together. A probability of 64 to 1 that these twin sisters are genetically identical has been adduced by a new method, involving comparison of their differences (or likenesses) in definite physical traits with the differences in these traits between them and their other sibs. They were reared apart from birth onward, being thirty-one when tested. Though in same general social class, their foster-parents, amounts of schooling, occupations, and adult lives have been extremely different. Intelligence tests agreed remarkably closely: A scored 153, B 156, on 'Army Alpha,' A 62, B 64, on 'Otis' Advanced'; as these are all 'Very Superior,' scores as high occurring less than once among 100 adults of their group, similarity is not a coincidence, but shows comparative lack of influence of environic differences of types here involved (e.g., schooling) on such features of intelligence as

these tests study, and, correlatively, the approximate genetic reliability of these tests, when confined to a given social class and territory. In striking contrast are results of non-intellectual mental tests—Downy Will-Temperament, Pressey Emotional and Social Attitude, Kent-Rosanoff Association, and tapping tests—which consistently showed great differences (often greater than given by persons taken at random), apparently explained by the life-histories. This demonstrates that the psychic differences measured by these tests have very little genetic basis, though other work has proved the tests significant psychologically.

137. *Linkage groups IV and VI in Drosophila virilis.* C. W. METZ and MILDRED S. MOSES, Carnegie Institution, Department of Genetics.

Drosophila virilis has six chromosomes—five long and rod-like, one small and dot-like. Also six groups of linked characters. Four of these groups contain five or more known characters and give large amounts of crossing-over (maps 65 to 120 units) and hence are assumed to represent four of the long chromosomes. The other two groups (IV and VI) contain five and three characters, respectively. Group IV has given no crossing-over and group VI about 5 per cent of crossing-over. These two groups are assumed to represent the remaining long chromosome and the dot-like one. Apparently crossing-over is partially or completely inhibited in the long chromosome. Not yet certain which group represents the long chromosome, but evidence, we believe, favors view that it is group IV. Group VI agrees with expectation both as regards number of genes and amount of crossing-over if it represents the small chromosome. On this view only the absence of crossing-over in the long chromosome needs explanation, whereas on the other view both chromosomes would be abnormal as regards amount of crossing-over and relative number of mutant genes. It may also be noted that two mutant characters in group VI resemble characters known to be associated with the dot-like chromosome in *Drosophila melanogaster*. None of those in group VI bear such a resemblance.

138. *A comparison of the heterozygotes from reciprocal crosses in the bar series of Drosophila melanogaster.* A. H. HERSH, Western Reserve University.

Flies from reciprocal crosses of the bar series of triple allelomorphs were raised at seven different temperatures over the interval 15° to 32°C. The data from these experiments demonstrate that the heterozygotes from reciprocal crosses differ significantly from each other in their mean facet number in two out of the three possible cases. This difference is an outcome of the fact that the percentage rate of decrease per degree increase in temperature differs for the heterozygotes from reciprocal crosses. Homozygous bar, the heterozygotes from bar ♀ × ultra-bar ♂, the heterozygotes from full ♀ × ultra-bar ♂ are similar to each other in showing a decrease in facet number of about 10 per cent per degree increase in temperature. Homozygous ultra-bar, the heterozygotes from ultra-bar ♀ × bar ♂, the heterozygotes from ultra-bar ♀ × full ♂ agree with each other in showing about an 8 per cent decrease. As a result of this difference of the heterozygotes in their temperature relations, the degree of dominance as calculated from the facet values varies not only with the temperature, but also with the direction in which the cross is made. It is clear that

this difference in the F_1 females from reciprocal crosses is not due to a difference in their genetic factors. It is suggested that the differential factors are to be found in the organization of the egg and that this difference has a value in the somatic expression of the genetic factors.

139. *A comparison of the effects of x-ray and temperature on linkage in Drosophila.* JAMES W. MAVOR and HENRY K. SVENSON, Union College, Schenectady, New York.

The investigation concerns crossing-over in the black-to-curved region of the second chromosome of *Drosophila melanogaster*. In the experiments the control, x-rayed, and heat-treated flies were sisters. The heat treatment was started at the same time as the x-ray treatment. The control, x-rayed, and heat-treated females (except for the heat treatment) were kept at a uniform temperature of 23°C. throughout the experiment.

The x-ray doses were used, one of ten, the other of twenty minutes, the Coolidge tube being run at 2.5 M.A., 50,000 volts with target distance 12.6 cm. During the critical period for x-ray and temperature effects (fifth to ninth days after beginning of treatment) the parent flies were transferred to new bottles each day.

The increase in the cross-over value of the x-rayed and heat-treated females appeared at approximately the same time in the F_1 , viz., in flies from eggs laid on the sixth or seventh day after the beginning of treatment.

In the heat-treated females the increase in cross-over value of the black-to-purple region appears one day earlier than in the purple-to-curved region, the former in bottles containing eggs laid on the sixth day, the latter in bottles containing eggs laid on the seventh day after treatment.

The increased cross-over value in the black-to-purple region in the x-rayed females persisted until the end of the experiment and was evident in eggs laid on the fourteenth and fifteenth days after a single x-ray treatment lasting twenty minutes.

140. *Some anomalies in Hadrobracon and their bearing on maturation, fertilization, and cleavage.* P. W. WHITING, University of Maine.

Cross-bred stocks have shown five cases of thelytoky. A tetraheterozygous female, $odwS/ODWs$, produced, in addition to sixteen expected classes of sons, a daughter, $ooDDWwSs$. If thelytoky occurs by omission of second maturation division, first division was here reductional for Oo and Dd , but equational for Ww and Ss . Five males with eyes mosaic as regards black and orange have been produced from heterozygous females, Oo . Orange as well as black regions have been proved matroclinous. One of these males, from female $oDwM/OdWm$, produced eleven black daughters from spermatozoa, $ODWm$, and 309 orange daughters from spermatozoa, $oDWM$ (eighty-seven tested). Gonads as well as eyes were therefore mosaic. First maturation division of egg producing this male was therefore reductional for Dd and Ww ; equational for Oo and Mm . Second division separated two nuclei, $ODWm$ and $oDWM$, each of which formed parts of body and gonads. Further evidence of similar nature shows that first maturation division of egg may be equational or reductional for various loci apparently according to chance. Characters of gynandromorphs are in agreement with Boveri's hypothesis of matroclinous nature of male parts.

141. *A microscopic analysis of genetic characters in Aplocheilus latipes.*
H. B. GOODRICH, Wesleyan University.

A mendelian analysis of genetic factors controlling pigmentation in the Japanese fish *Aplocheilus* has been made by Aida ('21). The present report is of preliminary observations on individuals of the same species imported into this country, but of unpedigreed stock. Yellows, whites, yellow speckled, and white speckled are easily recognizable. Microscopic examinations of the scales of the adult show that the variations in color effects are due to three types of pigment cells variously disposed. These types are melanophores, brown chromatophores, and xanthophores. The color of the yellow fish (bbYY) is produced by the xanthophores, but they also carry melanophores which are less numerous and carry less pigment than the darker colored fish. The white types (bbyy) carry a few faint melanophores and abundant cells homologous to the xanthophores, but usually without pigment. The speckled types (speckling due to melanophores) also show these cells faintly in the light areas.

These cells are identifiable in seven-day embryos. Counts of pigment cells made immediately after hatching separate the yellow and darker pigmented varieties, indicating a differentiation at a still earlier period.

142. *Rate of metabolism and sex control in Cladocera.* ARTHUR M. BANTA and L. A. BROWN, Station for Experimental Evolution, Cold Spring Harbor, Long Island, New York.

Previous reports concerned the effect of crowding of mothers (*Moina macrocopa*) upon the sex of their offspring—'crowded' mothers producing variable percentages of males, uncrowded mothers producing females only. On the assumption that the accumulation of excretory products is a factor in male production, various excretory products and related substances, and in addition certain unrelated substances, were introduced into different culture bottles. Some substances increased male production in crowded or semicrowded bottles, but most treatments produced consistent reduction in male production.

More recent experiments have shown that male production is increased by treatments which moderately retard the rate of metabolism of the mother at the time of maturation of the eggs. (The resultant males, however, have the higher metabolic rate as is characteristic probably for males in general.) Up to the point at which metabolism is seriously disturbed, the treatments in general are effective in roughly direct proportion to the extent of the retardation. Effective treatments include crowding, low temperature, and chloretone. Conversely, treatments which hasten metabolism during maturation of the eggs—aeration, alcohol, adrenal cortex, etc.—reduce or eliminate male production in crowded bottles.

Lowered rate of metabolism may possibly be the prime factor in male causation or the initiation of sexual production in *Cladocera* in general, in rotifers, and in certain diptera, aphids, phylloxerans, etc.

143. *Analysis of a right-left gynandromorph of Colias eurytheme var. alba.*
J. H. GEROULD, Dartmouth College.

Further study of a halved gynandromorph bred in 1913 from a heterozygous dominant white (orange recessive) female $\times$ male homozygous for female coloration. Right fore wing is a mosaic of white female and orange male (not recessive orange female) coloration. Its costal margin is male in size (shorter than the adjacent white female part, the margin of which protrudes slightly) and in color (lacking female marginal spots at the apex). Genetic constitution on the two sides at the two-cell stage was:

- A — A (white female coloration from the heterozygous mother).
- a — a (orange female coloration from the father).
- z — z (sex chromosome that successfully divides).
- z (z) (sex chromosome which fails to divide, the right half being suppressed).

Starting as a male oosperm, the right half of the embryo became imperfectly female. Maleness in early development in *Colias* is precocious. Hence male tissue grew across the median plane of the embryo against the right or female half. Result:

1. Male-like costal margin of the right fore wing.
2. Islands of orange male coloration in the white ground-color of this wing.
3. Male-like hind wing, except narrow streaks of white along the costal border.
4. Small lobe of the testis twisted about a larger normal left lobe, both containing mature spermatozoa.
5. Perfect median uncus and penis.
6. Small right clasp (valve) and, adjacent on the right, a still smaller right valve.

Female characters of right side include small eye, half labium (ovipositor) paired with half scaphium (male), half bursa and ostium bursae. No ovaries.

144. *Genetics of color in the pink and green aphid Macrosiphum solanifolii.*
A. FRANKLIN SHULL, University of Michigan.

Color in this aphid is due to multitudes of minute globules in the body fluid. The globules have characteristic differences of size and color, but with variations in the different forms of the aphid. Pink parthenogenetic females produce only pink offspring. Green parthenogenetic females produce only green parthenogenetic offspring and males and sexual females which, while not usually green, are characteristic of the green variety. The two color varieties are thus wholly unrelated during parthenogenetic reproduction. Crosses between males and sexual females of the same green line, or of different green lines, have yielded both green and pink offspring. Crosses between males and females of the same pink line yielded only one viable egg, which produced a pink line, though it seems likely that green lines might be obtained in the same manner, since crosses between different pink lines yielded both pink and green lines. Crosses between pink and green lines have yielded only green offspring, though it seems probable that pink lines may also be produced in this way. Attempts to secure F_2 lines have failed through non-viability of eggs. On the basis of these results,

the color differences cannot be regarded as due to a single factor difference, but probably rest upon multiple factors. The pink variety reproduces a little more slowly than the green, but this difference apparently is associated with the color and is not independently inherited.

145. *Inheritance of color patterns in the grouse locust, Telmatettix aztecus* Saussure. ROBERT K. NABOURS and BERTHA SNYDER, Kansas State Agricultural College.

Specimens were secured at Austin, Texas, and Los Angeles, California. The following factors for color patterns have been analyzed: —, producing a mottled gray all over, which is recessive to all the others; C, dull white on anterior pronotum; B1, black on anterior pronotum; H, green gray nearly all over; and R, dull brick red nearly all over. Of the 115 matings made only 62 were productive, and of 3511 offspring hatched 1938 were recorded. The heterozygote patterns produced by any two, except —, are intermediates. These factors make a series of five alternatives, or multiple allelomorphs.

Parthenogenesis. Twelve heterozygous females produced eighty-five offspring which became large enough to record, all females; forty-two having the one and forty-three having the other component pattern. Therefore, as in *Appotettix eurycephalus* (Nabours, '19), segregation of factors occurs in parthenogenetic as well as in bisexual reproduction.

146. *Chromosomes and sex in Sciara (Diptera)*. C. W. METZ, Carnegie Institution, Department of Genetics.

In a species of *Sciara* with which breeding experiments are being carried on (species not yet determined) the females have eight chromosomes (four pairs) and the males ten chromosomes. The latter include the four pairs found in the female and in addition two larger and individually distinct chromosomes, one V-shaped and one J-shaped. These resemble an XY pair, but neither is found in any of a large number of females examined.

In spermatocyte divisions six chromosomes are present, the large V and J being separate and unpaired. Buds resembling polar bodies appear to be thrown off at each division—no equal division has been observed. Presumably each primary spermatocyte produces only one spermatozoan. It is difficult to distinguish between first and second divisions, but both large chromosomes appear to divide in all cases and presumably go into all spermatozoa. If so, fertilized eggs should produce males, and females should be produced by some form of parthenogenesis. This is being tested genetically. Experiments indicate that females must be fertilized to give offspring. Single pairs or single wild females frequently give only females or only males. Others give various sex ratios. This may be due to differential mortality, but evidence is against such an interpretation.

147. *A self-fertile strain of Drosophila which is partially sterile in outcrosses*. H. H. PLOUGH, Amherst College, Amherst, Massachusetts.

A strain has appeared recently in a genetic experiment with *Drosophila* (begun without any intention of testing fertility in outcrosses) which is fertile in inbred cultures, but shows partial or complete sterility when outcrossed. From the

same original parents three stocks were made up by appropriate matings. One carries the sex-linked genes echinus-cut-garnet and the second chromosome gene black. A second carries the same set plus a sex-linked repressor of black. A third carries the sex-linked genes scute-crossveinless-vermilion-forked and black. Some difficulty was experienced with infertility in getting all these stocks, but by pair matings all have eventually become established and are self-fertile. Crosses of (1) and (3) showed entirely normal results with an average of 150 offspring per bottle. Crosses of (2) and (3) have given a total of less than fifty offspring for the twelve pair matings made to date. This apparently indicates that (2) carries genetic factors which make it infertile in an outcross having practically the same derivation, in spite of fair self-fertility. This stock shows similar infertility with several other stocks. The results are still incomplete and the tests are being continued.

148. *Chromosome breakage by x-rays and the production of eggs from genetically male tissue in Drosophila.* H. J. MULLER, University of Texas.

The double X-chromosome discovered by L. V. Morgan was used in these experiments because it is peculiarly suited for the detection of any breakages that may occur. Genetic tests showed that comparatively light doses of x-rays (36 to 55 Holtzknecht units) cause the breakage of this chromosome in about 2 per cent of eggs exposed at the susceptible stage. The susceptible stage, for this effect, is the maturation period—less than six days before the laying of the egg in question. The locus of breakage is probably at or near the bend of the V in most cases. The breakage caused by x-rays is of a different sort from that occurring sporadically in non-x-rayed material. Data from controls show that the 'natural' breakage is much less frequent, that it occurs more often in oogonia than at maturation, and that it is apt to break the chromosome asymmetrically, causing it to be so proportioned as to yield inviable zygotes when in combination with a normal X (the female then dying). Since the chromosome fragment lacking spindle attachment could not be carried along, it follows that after 'natural' breakage oogonia are formed which contain only one X-chromosome (and a Y-chromosome), with sex genes characteristic of spermatogonia, and that these nevertheless undergo oogenesis. In one such case the male composition must have been acquired about ten cell generations or more, antecedent to the primary oocytes, and any hypothetical intracellular 'female substances' originally present would have been diluted about a thousand times before egg formation commenced.

149. *On the occurrence of mutations within the transplantable cancer.* L. C. STRONG, St. Stephen's College, Annandale-on-Hudson, New York.

In analyzing the behavior of a transplantable tumor in a series of mice it was apparent that for the continued growth of the tumor in a given host there must be the simultaneous functioning of apparently six genetic factors. This tumor gave very uniform results for a period exceeding nine months. In a single experiment, involving eight F_2 individuals, all mice were susceptible. This result was so unexpected that one of the tumor masses was continued for investigation. It was soon apparent that this particular tumor would grow

not only in all F₁ individuals, but in all mice, irrespective of their racial origin. From being highly specific the tumor has apparently undergone an hereditary change involving a loss of tissue specificity. With this loss of specificity there is also obtained an increased growth vigor. Since this first change occurring in the original tumor mass, there have been two other independent changes leading to two tumors differing from the original tumor in producing different genetic ratios in the same series of hybrid mice. I have now four tumors, all arising from one original mass: a) original mass still giving a six-factor ratio; b) another giving two-factor ratio; c) a third giving a one-factor ratio, and, d) one showing complete loss of specificity. With a change in the physiological activity of the tumor cell (the cell being the unit of structure of the tumor mass), there may or may not be a histological change in the entire tumor tissue.

150. The inheritance of abnormal appendages among the descendants of x-rayed mice. C. C. LITTLE, University of Maine.

In previous papers the appearance of an abnormality of feet and legs among the descendants of x-rayed mice has been recorded. A preliminary report of its inheritance can now be made. It has so far been impossible to obtain a true breeding 'abnormal' line. On the other hand, the descendants of any two abnormals will usually have some abnormals among them. The proportion of abnormals differs in different families. A study of the material suggests the following genetic explanation: F = normal feet and legs; f = the gene for abnormal. All F₁ animals are normal regardless of other genes. M^a = gene modifying ff in the direction of normal; M^a = its allelomorph modifying ff in the direction of abnormal. M^aM^aff animals are usually normal, rarely abnormal; M^aM^aff animals are usually abnormal; M^aM^aff animals die, due to lethal action of M^aM^a. The relation in inheritance between the eye abnormality hh and the degree to which the foot-and-leg abnormality expresses itself suggests that the two variations are to some degree independent of one another.

151. The effect of x-rays on rats. LAWRENCE H. SNYDER, State College, Raleigh, North Carolina.

The testes of male rats were x-rayed with varying dosages. A dosage was found which gave the following results: normal fertility for two months following the raying, then a sterility period varying from two to six months, and then full fertility again. The first litter after sterility was raised in each case, and further generations obtained. Several hundred individuals have been obtained, reaching to the fourth generation, and all are normal and fertile.

152. The nature of the factors which determine shape. EDMUND W. SINNOTT, Connecticut Agricultural College.

In a cross between two squash types which differ radically in fruit shape and in fruit size (disc, large and sphere, small) and in which this difference is evidently due to a single factor, the extracted F₂ discs are distinctly smaller and the extracted spheres distinctly larger than the similar parental types and are about equal in volume. Similar results are found in all crosses between types

which differ in both size and shape. This indicates that factors for shape are really operative and are independent of those which control total size or amount of growth. Evidence is presented that shape is not due merely to dimensional factors, either independent or linked.

153. *Inheritance of color patterns in the grouse locust, Telmatettix aztecus* Saussure. ROBERT K. NABOURS and BERTHA SNYDER, Kansas State Agricultural College.

Specimens were secured at Austin, Texas, and Los Angeles, California. The following factors for color patterns have been analyzed: +, producing a mottled gray all over, which is recessive to all the others; C, dull white on anterior pronotum; Bl, black on anterior pronotum; H, green gray nearly all over, and R, dull brick red nearly all over. Of the 115 matings made only 62 were productive, and of 3511 offspring hatched 1938 were recorded. The heterozygote pattern produced by any two, except +, is intermediate. These factors make a series of five alternatives, or multiple allelomorphs.

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AMERICAN SOCIETY OF ZOÖLOGISTS

CONSTITUTION, OFFICERS, AND LIST OF MEMBERS OF THE SOCIETY

CONSTITUTION

ARTICLE I

NAME AND OBJECT

Section 1. The Society shall be called the "American Society of Zoölogists."

Sec. 2. The object of the Society shall be the association of workers in the field of Zoölogy for the presentation and discussion of new or important facts and problems in that science and for the adoption of such measures as shall tend to the advancement of zoölogical investigation in this country.

ARTICLE II

MEMBERSHIP

Section 1. Members of the Society shall be elected from persons who are active workers in the field of Zoölogy and who have contributed to the advancement of that science.

Zoölogists without the training in research required for full membership may be elected associate members of the Society.

Sec. 2. Election to membership in the Society shall be upon recommendation of the Executive Committee.

Sec. 3. Each member shall pay to the Treasurer an annual assessment as determined by the Society. This assessment shall be considered due at the annual meeting and the name of any member two years in arrears for annual assessments shall be erased from the list of members of the Society, and no such person shall be restored to membership unless his arrearages shall have been paid or he shall have been re-elected.

Sec. 4. Foreign Zoölogists, not members of this Society, may be elected Honorary Fellows upon unanimous recommendation of the Executive Committee by a majority vote of the members present at any meeting of the Society. Honorary Fellows shall not be required to pay dues.

ARTICLE III

OFFICERS

Section 1. The officers of the Society shall be a President, a Vice-President, a Secretary and a Treasurer and the members at large of the Executive Committee.

Sec. 2. The Executive Committee shall consist of the President, the Vice-President, the Secretary, the Treasurer and five members elected from the Society at

large. Of these five members, one shall be elected each year to serve five years. If any member at large shall be elected to any other office, a member at large shall be elected at once to serve out the remainder of his term.

Sec. 3. These officers shall be elected by ballot at the annual meeting of the Society and their official terms shall commence with the close of the annual meeting, except that the Secretary and the Treasurer shall be elected triennially and shall serve for three years.

Sec. 4. The officers named in Section 1 shall discharge the duties usually assigned to their respective offices.

Sec. 5. Vacancies in the board of officers, occurring from any cause, may be filled by election by ballot at any meeting of the Society. A vacancy in either the Secretaryship or the Treasurership occurring in the interval of the meetings of the Society may be filled by appointment, until the next annual meeting, by the Executive Committee.

Sec. 6. At the annual meeting the President shall name a nominating committee of three members. This committee shall make its nominations to the Secretary not less than one month before the next annual meeting. It shall be the duty of the Secretary to mail the list of nominations to all members of the Society at least two weeks before the annual meeting. Additional nominations for any office may be made in writing to the Secretary by any five members at any time previous to balloting.

ARTICLE IV

MEETINGS OF THE SOCIETY

Section 1. Unless previously determined by the Society the time and place of the annual meeting of the Society shall be determined by its Executive Committee. Special meetings may be called and arranged for by the Executive Committee. Notices of such meetings shall be mailed to all members of the Society at least two weeks before the date set for the meeting.

Sec. 2. Sections of the Society may be organized in any locality by not less than ten members, for the purpose of holding meetings for the presentation of scientific papers. Such sections shall have the right to elect their own officers and also associate members; provided, however, that associate membership in any section shall not confer membership in the Society.

ARTICLE V

QUORUM

Twenty-five members shall constitute a quorum of the Society and four a quorum of its Executive Committee.

ARTICLE VI

CHANGES IN THE CONSTITUTION

Amendments to this Constitution may be adopted at any meeting of the Society by a two-thirds vote of the members present, upon the following conditions:

(a) The proposed amendment must be in writing and signed by at least five members of the Society.

(b) This signed proposal must be in the hands of the Secretary at least one month before the meeting of the Society at which it is to be considered.

(c) The Secretary shall mail copies of the proposed amendment to the members of the Society at least two weeks before the meeting.

BY-LAWS

DUES

(1) The annual dues for members or associate members, unless remitted or changed by the vote of the Society, shall be seven dollars.

SECRETARY

(2) The duties and privileges of the Secretary shall be as follows:

(a) He shall keep the records of the Society.

(b) Whenever the proper officers of a number of related societies shall have a conference with a view of determining a common time and place for the several annual meetings, he shall act as the delegate or representative of this Society. (See also 5.)

(c) He shall employ a typewriter or printer whenever in his judgment such employment will expedite the business of the Society, and

(d) He shall be reimbursed out of the funds of the Society for expenses incurred in attending meetings of the Society.

TREASURER

(3) The duties and privileges of the Treasurer shall be as follows:

(a) He shall be in charge of the funds of the Society.

(b) At the Annual Business Meeting of the Society he shall present a statement to date of the funds of the Society.

(c) He shall employ a typewriter or printer whenever in his judgment such employment will expedite the business of the Society.

AUDITING COMMITTEE

(4) The President shall annually appoint an auditing committee of two, who shall audit and report upon the financial record and statement of the Treasurer at the meeting for which they were appointed.

(5) The National Research Council allows the Society three representatives on the Division of Biology and Agriculture. Of these three representatives, one shall be elected each year to serve three years. The method of election shall be the same as that used in the election of the officers of the Society.

MEETINGS

(6) It shall be the policy of the Society to hold meetings in both Eastern and Central-Western territory, and the distribution of the meetings between the two territories shall be determined in general on the basis of the representation of Eastern and Western members in the Society. See also 2-b.

PROGRAM RULES

(7) In matters relating to programs for annual meetings the following rules shall be observed:

(a) Papers shall be listed and presented according to subject matter in the following groups: 1. Comparative Anatomy; 2. Embryology; 3. Cytology; 4. Genetics; 5. Comparative and General Physiology; 6. Ecology, and 7. Miscellaneous, or other groups at the discretion of the Secretary.

(b) Whenever conditions require it the Executive Committee shall schedule two or more groups for the same hour and rearrange the program to bring together papers on subjects of more general interest for meetings of the whole Society. The Committee, however, is instructed to avoid conflicts as much as possible.

(c) Papers shall be listed in their respective groups in the order received. When a member offers more than one paper those following the one designated first shall be placed at the end of the list and shall not be read until all first papers by members shall have been twice called for.

(d) All papers not read when called for as listed shall be placed at the end of the group list, and, if not read when called for the second time, they shall be read by title only.

(e) The titles of "introduced" papers shall be listed in the groups after the titles of papers to be read by members. Such papers shall be read by title only in case the entire program cannot be completed during four regular sessions for reading papers.

(f) Fifteen minutes shall be the maximum time allowed for the presentation of a paper.

(g) Abstracts of papers for publication in the proceedings of the Society must be handed to the Secretary or his representative before final adjournment of the annual meeting.

ASSOCIATE MEMBERS

(8) Associate members may become members of sections of the Society and are entitled to the journal privileges of members.

HISTORICAL REVIEW

A review of the historical antecedents of the present American Society of Zoölogists will be found in *The Anatomical Record* for January, 1917. The list of officers and meeting places of the present Society found in the same place is brought up to date and reprinted here.

LIST OF FORMER OFFICERS

AMERICAN MORPHOLOGICAL SOCIETY

<i>President</i>	<i>Vice-President</i>	<i>Secretary-Treasurer</i>
1890—E. B. Wilson		J. P. McMurrich
1891—C. O. Whitman	E. L. Mark	J. P. McMurrich
1892—C. O. Whitman	H. F. Osborn	J. P. McMurrich
1893—C. O. Whitman	E. B. Wilson	J. P. McMurrich
1894—C. O. Whitman	W. B. Scott	G. H. Parker
1895—E. B. Wilson	W. B. Scott	G. H. Parker
1896—E. L. Mark	H. F. Osborn	G. H. Parker
1897—C. S. Minot	S. I. Smith	G. H. Parker
1898—H. F. Osborn	T. H. Morgan	G. H. Parker
1899—E. G. Conklin	W. M. Wheeler	Bashford Dean
1900—T. H. Morgan	H. C. Bumpus	J. S. Kingsley
1901—J. S. Kingsley	E. A. Andrews	T. H. Montgomery
1902—H. C. Bumpus	G. H. Parker	M. M. Metcalf

Additional Members of the Executive Committee

1891—E. B. Wilson	1897—J. S. Kingsley
H. F. Osborn	Bashford Dean
1892—E. L. Mark	1898—C. B. Davenport
T. H. Morgan	F. R. Lillie
1893—T. H. Morgan	1899—J. P. McMurrich
C. B. Davenport	G. H. Parker
1894—E. A. Andrews	1900—F. R. Lillie
F. H. Herrick	Jacob Reighard
1895—T. H. Morgan	1901—C. F. W. McClure
S. Watase	C. W. Hargitt
1896—E. G. Conklin	1902—H. S. Jennings
William Patten	R. G. Harrison

AMERICAN SOCIETY OF ZOÖLOGISTS

EASTERN BRANCH	<i>President</i>	CENTRAL BRANCH
G. H. Parker	1903	Jacob Reighard
E. A. Andrews	1904	C. H. Eigenmann
W. E. Castle	1905	F. R. Lillie
W. E. Castle	1906	C. C. Nutting
C. B. Davenport	1907	S. A. Forbes
W. M. Wheeler	1908	E. A. Birge
H. S. Jennings	1909	E. A. Birge
T. H. Montgomery	1910	C. E. McClung
H. V. Wilson	1911	George Lefevre
A. G. Mayer	1912	H. B. Ward
Raymond Pearl	1913	H. B. Ward

LIST OF FORMER OFFICERS

EASTERN BRANCH	<i>Vice-President</i>	CENTRAL BRANCH
Jacob Reighard	1903	H. F. Nachtrieb
W. E. Castle	1904	S. J. Holmes
William Patten	1905	William A. Locy
William Patten	1906	George Lefevre
F. H. Herrick	1907	H. B. Ward
H. S. Jennings	1908	M. F. Guyer
H. V. Wilson	1909	M. F. Guyer
H. H. Wilder	1910	H. F. Nachtrieb
H. E. Crampton	1911	R. H. Walcott
G. A. Drew	1912	C. M. Child
Alex. Petrunkevitch	1913	C. M. Child

Secretary-Treasurer

G. A. Drew	1903	Frank Smith
G. A. Drew	1904	F. R. Lillie
H. S. Pratt	1905	C. E. McClung
H. S. Pratt	1906	T. G. Lee
C. J. Herrick	1907	T. G. Lee
L. L. Woodruff	1908	T. G. Lee
L. L. Woodruff	1909	Charles Zeleny
H. W. Rand	1910	H. V. Neal
Raymond Pearl	1911	H. V. Neal
J. H. Gerould	1912	W. C. Curtis
Caswell Grave	1913	W. C. Curtis

Executive Committeemen

F. R. Lillie	George Lefevre
T. H. Montgomery	T. G. Lee
H. C. Bumpus	Herbert Osborn
H. S. Jennings	C. H. Eigenmann
E. A. Andrews	J. G. Needham
W. R. Coe	S. J. Holmes
G. A. Drew	W. A. Locy
M. M. Metcalf	C. M. Child
D. H. Tennent	R. H. Walcott
R. G. Harrison	W. C. Curtis
H. E. Jordan	Oscar Riddle
C. E. McClung	H. B. Ward
	Chauncey Juday
	H. W. Norris
	C. E. McClung
	H. F. Nachtrieb

AMERICAN SOCIETY OF ZOÖLOGISTS (AMALGAMATED)

<i>President</i>	<i>Vice-President</i>	<i>Executive Committeemen</i>
1914. C. E. McClung	M. F. Guyer	H. E. Jordan—1 year H. F. Nachtrieb—2 years H. V. Wilson—3 years George Lefevre—4 years A. F. Shull—5 years
1915. W. A. Loey	W. E. Ritter	D. H. Tennent
1916. D. H. Tennent	Charles Zeleny	R. P. Bigelow—5 years L. J. Cole—4 years H. V. Wilson
1917. M. M. Metcalf	Charles Zeleny	M. M. Metcalf
1918. George Lefevre	L. L. Woodruff	George Lefevre
1919. C. M. Child	H. H. Wilder	C. M. Child
1920. Gilman A. Drew	Caswell Grave	G. A. Drew
1921. Charles A. Kofoid	Aaron L. Treadwell	C. A. Kofoid
1922. H. H. Wilder	Bennet M. Allen	H. H. Wilder
1923. M. F. Guyer	Robert A. Budington	M. F. Guyer
1924. R. G. Harrison	R. K. Nabours	

Secretary-Treasurer

1914-1918. Caswell Grave
1918-1921. W. C. Allee

Secretary

1921. W. C. Allee

Treasurer

1922. D. H. Tennent
1923. Robert H. Bowen

*Representative in the Division of Biology and Agriculture,
National Research Council*

M. F. Guyer 1919-1921 G. H. Parker 1919-1922 F. R. Lillie 1919-1923
William Patten 1921-1924

Associate Editors of the Journal of Morphology

1921

Gary N. Calkins J. S. Kingsley William Patten

1921-22

E. G. Conklin M. F. Guyer W. M. Wheeler

1921-23

C. A. Kofoid F. R. Lillie J. T. Patterson

LIST OF PLACES OF MEETING

AMERICAN MORPHOLOGICAL SOCIETY

1890—Boston	1894—Baltimore	1899—New Haven
1891—Philadelphia	1895—Philadelphia	1900—Baltimore
1892—Princeton	1896—Boston	1901—Chicago
1893—New Haven	1897—Ithaca	1902—Washington
	1898—New York	

CENTRAL NATURALISTS

1899—Chicago

1900—Chicago

SOCIETY OF AMERICAN ZOÖLOGISTS

1901—Chicago

1902—Washington

AMERICAN SOCIETY OF ZOÖLOGISTS

EASTERN BRANCH

1903—Philadelphia

1904—Philadelphia

1906—New York

1907—New Haven

1909—Boston

1910—Ithaca

JOINT MEETINGS

1905—Ann Arbor

1908—Baltimore

1911—Princeton

1912—Cleveland

1913—Philadelphia

CENTRAL BRANCH

1903—St. Louis

1905—(Mch.) Chicago

1907—(Mch.) Madison

1907—Chicago

1910—(Apr.) Iowa City

1910—Minneapolis

1912—(Apr.) Urbana

MEETING PLACES

1914—Philadelphia

1915—Columbus

1916—New York

1917—Minneapolis

1918—Baltimore

1919—St. Louis

1920—Chicago

1921—Toronto

1922—Boston

1923—Cincinnati

1924—Washington

AMERICAN SOCIETY OF ZOÖLOGISTS

OFFICERS AND LIST OF MEMBERS¹

Officers for 1924

<i>President</i>	R. G. HARRISON
<i>Vice-President</i>	R. K. NABOURS
<i>Secretary</i>	W. C. ALLE
<i>Treasurer</i>	R. H. BOWEN

Executive Committee

C. M. CHILD	1924
GILMAN A. DREW	1925
CHARLES A. KOFOID.....	1926
H. H. WILDER	1927
M. F. Guyer.....	1928

Officers of Genetics Section

<i>Chairman</i>	W. E. CASTLE
<i>Secretary</i>	D. F. JONES
<i>Representative of the Botanists</i>	A. F. BLAKESLEE
<i>Representative on Board of Control of Botanical Abstracts</i>	SEWALL WRIGHT
<i>Representative on Editorial Board of Journal of Heredity</i>	G. H. SHULL

Representative of the Society in the Division of Biology and Agriculture of the National Research Council

H. S. JENNINGS	1925
E. G. CONKLIN	1926
J. T. PATERSON	1927

EDITORIAL BOARD OF THE JOURNAL OF MORPHOLOGY

Managing Editor (term expires 1926).....C. E. McCLUNG

Associate Editors

To serve until 1925.....	{ G. A. DREW
	{ H. V. NEAL
	{ L. L. WOODRUFF
To serve until 1926.....	{ CASWELL GRAVE
	{ D. H. TENNENT
	{ H. V. WILSON
To serve until 1927.....	{ A. A. SCHAEFFER
	{ HELEN DEAN KING
	{ S. O. MAST

¹ The data given in this list are based on the last preceding list published in THE ANATOMICAL RECORD, Vol. 26, No. 5, with such corrections and additions as have come to the attention of the Secretary. Please notify the Secretary of errors in this copy of the membership list that they may be corrected in the next published list.

HONORARY FELLOW

BATESON, WILLIAM, The John Innes Horticultural Institution, The Manor House, Merten, S. W. 19, England.

LIFE MEMBERS

ANDREWS, ETHAN ALLEN, Ph.B. (Yale), Ph.D. (Johns Hopkins), Professor of Zoölogy, *Johns Hopkins University, Baltimore, Md.*

DEAN, BASHFORD, A.B. (College of City of New York), A.M., Ph.D. (Columbia), Professor of Vertebrate Zoölogy, Columbia University; Curator Emeritus of Fishes and Reptiles, *American Museum Natural History, Riverdale-on-Hudson, New York.*

HENSHAW, SAMUEL, Director of Museum of Comparative Zoölogy, *8 Fayerweather Street, Cambridge, Mass.*

METCALF, MAYNARD MAYO, A.B., Sc.D. (Oberlin), Ph.D. (Johns Hopkins), Orchard Laboratory, *128 Forest Street, Oberlin, Ohio.*

MOORE, J. PERCY, Ph.D. (Pennsylvania), Professor of Zoölogy, *University of Pennsylvania, Philadelphia, Pa.*

STILES, CHARLES W., A.M., Ph.D. (Leipzig) S.M., S.D. (Wesleyan), Professor of Zoölogy, United States Public Health and Marine Hospital Service, Hygienic Laboratory. *Twenty-fifth and E Streets, N. W., Washington, D. C.* (October 1-May 1); *Wilmington, N. C.* (May-October 1).

ACTIVE MEMBERS

ACKERT, JAMES EDWARD, A.B., A.M., Ph.D. (University of Illinois), Professor of Zoölogy, Parasitologist Agr. Exp. Station; *Kansas State Agricultural College, Manhattan, Kan.*

ADOLPH, EDWARD FREDERICK, A.B., Ph.D. (Harvard), Fellow in Zoölogy of the National Research Council, *Zoölogical Laboratory, The Johns Hopkins University, Baltimore, Md.*

AGERSBERG, HELMER P(ARELI VON WOLD) K(JERSCHOW), S.B., S.M. (Washington), A.M. (Columbia), Ph.D. (Illinois), Professor of Biology, *Millikin University, Decatur, Illinois.*

ALEXANDER, CHARLES PAUL, B.S., Ph.D. (Cornell), Assistant Professor of Entomology, Massachusetts Agricultural College, *Fernald Hall, Amherst, Mass.*

ALLEE, WARDER CLYDE, S.B. (Earlham College), S.M., Ph.D. (Chicago), Associate Professor of Zoölogy, *University of Chicago, Chicago, Ill.*

ALLEN, BENNET M., Ph.B. (DePauw), Ph.D. (Chicago), Professor of Biology, University of California (Southern Branch), *909 Micheltorena St., Los Angeles, Calif.*

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ALLEN, WILLIAM RAY, A.B., A.M., Ph.D. (Indiana), Assistant Professor of Zoölogy, Kentucky State University, *417 Clifton Ave., Lexington, Ky.*

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- BAKER, ARTHUR CHALLENGE, B.S.A. (Toronto University), Ph.D. (George Washington University), Entomologist, *U. S. Bureau of Entomology, Washington, D. C.*
- BAKER, HORACE BURRINGTON, B.S., Ph.D. (Michigan), Instructor of Zoölogy, University of Pennsylvania, *Zoölogical Laboratory, University of Pennsylvania, Philadelphia, Pa.*
- BANTA, ARTHUR MANGUN, A.B., A.M. (Indiana), Ph.D. (Harvard), Resident Investigator, *Station for Experimental Evolution, Carnegie Institution, Cold Spring Harbor, Long Island, N. Y.*
- BARKER, FRANKLIN D., A.B., A.M. (Ottawa), Ph.D. (Nebraska), Professor of Medical Zoölogy, *University of Nebraska, Station H., Lincoln, Neb.*
- BARROWS, WILLIAM MORTON, B.S. (Michigan Agricultural College), S.B., S.M., S.D. (Harvard), Department of Zoölogy and Entomology, *Ohio State University, Columbus, Ohio.*
- BARTELMIZ, GEORGE W., Ph.D. (Chicago), Associate Professor of Anatomy, *University of Chicago, Chicago, Ill.*
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- BIGELOW, ROBERT PAYNE, S.B. (Harvard), Ph.D. (Johns Hopkins), Professor of Zoölogy and Parasitology, *Massachusetts Institute of Technology, Cambridge, Mass.*
- BINFORD, RAYMOND, B.S. (Earlham), S.M. (Chicago), Ph.D. (Johns Hopkins), President of Guilford College, *Guilford, N. C.*
- BLANCHARD, FRANK N., A.B. (Tufts), Ph.D. (Michigan), Instructor in Zoölogy, University of Michigan, *University of Michigan, Ann Arbor, Mich.*
- BODINE, JOSEPH HALL, A.B., Ph.D. (Pennsylvania), Instructor in Zoölogy, University of Pennsylvania, *Zoölogical Laboratory, University of Pennsylvania, Philadelphia, Pa.*
- BORING, ALICE MIDDLETON, A.B., A.M., Ph.D. (Bryn Mawr), Visiting Professor of Biology, Peking University, *Yenching College, Peking, China.*
- BOWEN, ROBERT HALL, A.B. (Colby), A.M., Ph.D. (Columbia), Assistant Professor of Zoölogy, Columbia University, *Department of Zoölogy, Columbia University, New York City.*

- BOYDEN, E. A., A.B., A.M., Ph.D. (Harvard), Assistant Professor Comparative Anatomy, *Harvard Medical School, 61 Clark Street, Newton Center, Mass.*
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- BURROWS, MONTROSE T., A.B. (Kansas), M.D. (Johns Hopkins), Associate Professor Exp. Surgery, Director of Research Laboratories, *Barnard Free Skin and Cancer Hospital, Washington University Medical School, Kingshighway and Euclid Avenue, St. Louis, Mo.*
- BYRNES, ESTHER F., Ph.D. (Bryn Mawr), Teacher of Biology, Girls' High School, Brooklyn, *193 Jefferson Avenue, Brooklyn, N. Y.*
- CALVERT, PHILIP POWELL, Ph.D. (Pennsylvania), Professor of Zoölogy, *University of Pennsylvania, Zoölogical Laboratory, Philadelphia, Pa.*
- CAMERON, ALFRED ERNEST, M.A., B.Sc., D.Sc. (Aberdeen, Scot.), M. Sc. (Manchester, Eng.), Professor of Zoölogy, Department of Zoölogy, University of Saskatchewan, *Saskatoon, Sask.*
- CAROTHERS, E. ELEANOR, A.B., A.M., Ph.D., *Zoölogical Building, University of Pennsylvania, Philadelphia, Pa.*
- CARPENTER, FREDERIC WALTON, B.S. (New York University), A.M., Ph.D. (Harvard), Professor of Biology, *Trinity College, Hartford, Conn.*
- CASTEEL, DANA BRACKENRIDGE, A.B. (Allegheny), A.M. (Ohio Wesleyan), Ph.D. (University of Pennsylvania), Professor of Zoölogy, *University of Texas, Austin, Texas.*
- CASTLE, WILLIAM E., A.B. (Denison), A.M., Ph.D. (Harvard), Professor of Zoölogy in Harvard University, *186 Payson Road, Belmont, Mass.*
- CHAMBERS, ROBERT, JR., M.A. (Queen's University, Can.), Ph.D. (Munich), Professor of Microscopic Anatomy, *Cornell University Medical College, 28th Street and First Avenue, New York City.*
- CHAPMAN, ROYAL N., B.A., M.A. (Minnesota), Ph.D. (Cornell), Assistant Professor of Animal Biology; Assistant Entomologist, Experiment Station, University of Minnesota; *305 Animal Biology, University of Minnesota, Minneapolis, Minn.*
- CHESTER, WAYLAND MORGAN, A.B., A.M. (Colgate University), Professor of Biology, *Colgate University, Hamilton, N. Y.*
- CHIDESTER, FLOYD EARLE, Ph.B. (Syracuse), Ph.D. (Clarke), Professor of Zoölogy in charge of Course in Public Health, *West Virginia University, Morgantown, W. Va.*
- CHILD, CHARLES MANNING, Ph.B., M.S. (Wesleyan), Ph.D. (Leipzig), Professor of Zoölogy, *Hull Zoölogical Laboratory, University of Chicago, Chicago, Ill.*
- CHURCHILL, EDWARD PERRY, A.B. (Iowa), Ph.D. (Johns Hopkins), Professor of Zoölogy, *University of South Dakota, Vermilion, S. D.*
- CLEMENS, LUCY SMITH, B.A., M.A. (Mt. Holyoke), Ph.D. (Cornell), *Pacific Biological Station, Nanaimo, B. C., Canada.*

- CLEVELAND, LEMMIE ROSCOE, B.S. (Mississippi), Sc.D. (Hopkins), Fellow in the Biological Sciences, National Research Council, *310 W. Monument St., Baltimore, Md.*
- COE, WESLEY R., Ph.D. (Yale), Professor of Biology, *Yale University, New Haven, Conn.*
- COGHILL, GEORGE E., A.B., Ph.D. (Brown), Professor and Head of Dept. of Anatomy, University of Kansas, *R.F.D. 9, Lawrence, Kan.*
- COKER, ROBERT ERVIN, B.S., M.S. (North Carolina), Ph.D. (Hopkins), Professor of Zoölogy, University of North Carolina, *Chapel Hill, N. C.*
- COLE, LEON J., A.B. (Michigan), Ph.D. (Harvard), Chief, Animal Husbandry Division, *U. S. Department of Agriculture, Washington, D. C.*
- COLE, WILLIAM H (ARDER), A.B. (Hamilton), A.M., Ph.D. (Harvard), Professor of Biology, Department of Biology, *Clark University, Worcester, Mass.*
- COLLETT, MARY ELIZABETH, A.B. (Wellesley), A.M., Ph.D. (Pennsylvania), Instructor in Physiology, Dept. of Medicine, University of Buffalo, *University of Buffalo (Medical), 24 High Street, Buffalo, N. Y.*
- COLLINS, HENRY HOMER, A.B. (Rochester Normal), S.B., A.M., Ph.D. (California), Associate Professor of Biology, University of Pittsburgh, *916 Adelaide Street, Pittsburgh, Pa.*
- COLTON, HAROLD SELLERS, B.S., M.A., Ph.D. (Pennsylvania), Assistant Professor of Zoölogy, *University of Pennsylvania, Philadelphia, Pa.*
- CONKLIN, EDWIN GRANT, Ph.D. (Johns Hopkins), Sc.D. (Pennsylvania), Professor of Biology, *Princeton University, Princeton, N. J.*
- COPELAND, MANTON, S.B., S.M., Ph.D. (Harvard), Professor of Biology, *Bowdoin College, Brunswick, Maine.*
- CORT, WILLIAM W (ALTER), A.B. (Colorado College), A.M., Ph.D. (University of Illinois), Associate Professor of Helminthology, School of Hygiene and Public Health, *Johns Hopkins Univ., 310-312 W. Monument St., Baltimore, Md.*
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